THE

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LIGHT RAILWAYS *v.* LIGHT ROAD LOCOMOTIVES.

A CORRESPONDENT of the *Engineer* writes in favour of the road locomotive as against the light railway, and we are bound to admit that he has a very good case upon which to base his arguments.

In the first place, there is the hard fact that nearly 7,000 road engines are at work in the British Isles. This is about 30 per cent. of the number of railroad locomotives. True the promoters of light railways may say that this is simply because of the lack of light railways, but, on the other hand, we cannot forget that all this progress has been made in the face of very discouraging legislation. The road engine has been legislated against by two great factions, the country gentleman interest and the railway shareholder in Parliament, and what M.P. is not a shareholder or director of some railway?

It is a fact, also, to be noted that the capital sunk in the English roads represents many millions of pounds. The roads were made for the old horse coaches, and when about completed, their use quickly ceased, the coaches being driven off by the rapid growth of railways. Thus the roads remained very little used until to-day, and but for the farmers' few carts and market traps, they have become recognised as the property of the cyclist. They have admirable surfaces for the road engine, and now that the steam roller is becoming so common, their repair is better effected than ever it has been.

Again, if from any cause the traffic along a line of road were to cease, there would be no difficulty in removing the engines to another route. This cannot be done with a railway. The engines may be removed, but the rails remain, and all the capital outlay represented by the road becomes dead and useless.

These are weighty arguments in favour of road engines, and to set against them there is only the extra speed possible on rails and cheaper traction, but even then there is the advantage that the road engine can go anywhere and is not tied to where there are rails. It can enter the farmer's yard, and can draw the farmer's own waggons just as they are loaded up in the fields, and it is difficult to see how for the purposes of the farmer the light railway can compete in convenience with the road. With forthcoming legislation calculated to render the working of road engines very much less harassing than it has been in the past, it is not too much to expect a great advance in both construction and use. Whatever may be the outcome it is certain that there is work coming forward for engineers, either in the construction of railways or of engines and steam rollers. The electrical industry will reap some of the benefit. There are numerous lines of traffic where there can be no hesitation in putting down light railways, and that these will be worked electrically in many

cases is certain. It is not the province of electricians to discourage the use of road engines however actuated. They have their proper field of work and we hope to see their activity enormously increased should the legislation now pending be carried through in a liberal and common sense manner. We are persuaded that the road engine and the electrical tramway are complements of each other, that one will tend to the advantage of the other, and the general benefit of the country, to the advantage also of existing railways. The country needs cheaper carriage facilities and has determined to have them. We can hardly hope that legislative wisdom will produce a locomotive act that will be all that is desirable. It would be asking too much, but the thin end of the wedge has entered and any foolish restrictions will be easier removed in the future than in the past.

THE DIRECT CONNECTION OF ELECTRIC MOTORS WITH MACHINES.

This subject is very well considered by Mr. Baxter, in the *Electrical World* (New York). In advocating the total abolition of shafting, people often overlook the conditions under which shafting is working. The loss or absorption of power by a shaft is not great of necessity. Much depends upon the length of a shaft relatively to the power taken off it. Thus, as pointed out, a line of shafting delivering power at the rate of 1 horse-power per foot of length does not absorb 50 times as much power as a shaft only giving off a horse-power for every 50 feet of length, and in considering electrical driving we must bear in mind the amount of shafting we are going to abolish per horse-power. At present prices, it would never do to remove the line shafts in the preparation or card room of a cotton factory, and put separate motors on each of 50 or 60 machines on a floor. Small motors are less efficient than large ones, and more liable to get out of order. Thus, in a plan before us, three line shafts are shown driving an average of 40 machines, each placed as close together as possible. This is in one room. In three upper rooms there is but one shaft in each, and each shaft delivers probably 200 H.P. at least, or fully a horse-power per foot of its length. In the case of these three upper rooms, where the number of machines would be smaller, motors might be applied to each side of a "self-actor," but it is doubtful whether in a textile factory there is yet good reason to abolish shafting even when electrical power can be brought from a distant source. There might be separate motors to each shaft, but there the economy would probably cease. The case is different entirely in an engineer's shop, where machine tools are not placed near together, nor are they run either together or continuously. In another column will be found a brief abstract of Mr. Adamson's recent paper on this subject. Mr. Adamson does not deal with the matter as it relates, however, to closely packed machinery. Mr. Baxter refers to quite small powers, and he concludes that any combination involving motors of less than 1 horse-power would not be advisable. Indeed, he appears to perceive that the special function of electricity is to transmit power to machinery through considerable distances, not to replace shafting which is run transversely across a large number of very narrow machines. Direct connection is a great desideratum, but there is just a tendency to let the idea run wild, and to advocate separate motors where no possible economy can be expected. The tendency is very much on a par with the feeling that culminated in the Heilmann engine, and lies beyond that invisible border line separating the practicable from the undesirable. That shafting is bad under certain conditions seems to be a sufficient excuse to condemn it in every situation. In textile factories, shafting is seen at its best. Its load is heavy per foot of shaft, the bearings are attended to, and there is no dust of a gritty nature as in most other works.

Self-Induction and Capacity.

When it is explained that as an effect of self-induction the wave of current in an alternate current circuit lags behind the wave of E.M.F. impressed on that circuit, the connection between cause and effect is clear. But when (as is the custom) it is further explained that the effect of capacity is to cause the wave of current to precede or be in advance of the wave of E.M.F., a needless difficulty is introduced, against which Mr. Mordey very properly protests in the course of the discussion at the Northern Society's meeting, pointing out that the effect cannot precede the cause, and that the current is not in advance of the E.M.F. producing it, but behind that wave and in advance of the next following wave of E.M.F. In this way it is proposed to get rid of the difficulty—doubtless quite a real one to many a learner—of the effect appearing to precede the cause. This certainly seems to make for simplicity.

Self-Demagnetising Factors.

In making tests of rods by the magnetometer method, it is usual to assume that as far as the self-demagnetising forces are concerned, the cylinder is equivalent to a very long ellipsoid. That this assumption is not quite true is well known, and the question has been gone into by several observers. The latest research on the question is by Mr. C. R. Mann. He finds that up to a certain value of the intensity of magnetisation, at about the point where the linear relation between I and H ceases in the reversal curve, the cylinder is very nearly represented by an ellipsoid, but after that the ellipsoid takes up a much greater magnetisation for the same magnetising force than does the cylinder. For a length ratio of 20 to 30 the deviation from the corresponding ellipsoids is a maximum.

Water Power Electrical Plants in the United States.

Some figures collected by Mr. B. C. Washington and contributed to the *Electrical World* (New York) show that there are to-day fully 300 places where water power is driving dynamos for lighting and power purposes. Out of 150 circulars he got back fully filled with answers to a given list of questions, he selects 124 for tabulation, and finds that nearly 40 per cent. are in the New England States; over 65 per cent. have less than 20 feet head of water, so that there is nothing magnificent or startling about them, but plain everyday engineering, and in many cases mills with water-power supply their own light, and light the adjacent village also, as well as supplying power outside. Frequently the dynamo is on the shaft of the turbine, and a common type of turbine is the double wheel on a horizontal shaft. Fully half the plants have additional steam power for emergencies. In the list given there are over 3,000 arc, 100,000 incandescent lights, and 82 miles of electric railway operated by water power. Several of the systems are illustrated, and these serve to show the very simple arrangements that can be contrived with turbines and dynamos. There may not be much water power in the United Kingdom, but there is considerable water power in Ireland that might be utilised to advantage. The rapids of the Shannon at Killaloe represent a considerable fall, and when it is considered that the Shannon rolls to the sea a volume of water said to be equal to the joint flow of the Thames, Severn, Trent, and Mersey, some idea may be formed of its size, while the large lakes in its course ensure uniformity of flow.

QUICK METHODS OF TESTING FOR FAULTS IN ELECTRIC WIRING.*

By A. E. HUTCHINS.

We will start with a complete system of wiring, say for a large office building, hotel or factory, where a complete equipment of multiple (two-wire) system of electric wiring has been installed, with generating plant included, and cut-outs and fuses and switches placed and connected; also instruments (for governing and regulating dynamos and plant) placed on switchboard. The house wiring will consist of a number of feeders or risers running from the bus-bars on the switchboard of the generating plant or dynamo-room and thence to different sections and stories of the building, or buildings, where they severally end at distributing or cut-out boxes, where a number of branch, or lighting and motor, or electric heating circuits converge or get their supply. The feeder or riser circuits are also connected at or near the feeder ends with a set of wires we will call helper or equaliser wires, that are run from one feeder to another and another, and so on, for the purpose of providing a means whereby one feeder, if over-burdened with current, may be, through these equaliser wires, assisted from another feeder or feeders, and so borrow or lend. Not to have too many complications, we will employ one set of tell-tale wires running from the principal feeder and back to the switchboard. The electric fixtures and drop lights have been put up and connected and lamps are in. Fan and other motors ready to run an electric heating apparatus are connected. The buildings are also equipped with gas, steam, and water conductors.

A man is sent to start the electric generators and give the plant a trial run. We will say that he has undertaken to run it and finds that nothing will work. We will say he then calls upon the reader and myself to first dissect the wiring and see where the trouble or difficulties lie. To start in, we will first disconnect the different feeders at the switchboard of the main bus-bars, and then we will connect the terminals of a magneto (first used to test with) to one set of feeder wires, remembering that if the two leads of the feeder are cross-connected by a conducting channel anywhere else than the winding of the magneto, then by turning the magneto (or generator) the magneto bell will ring. We will now see that all the incandescent lamps in the entire building are disconnected, as their filaments afford a path from one side of the feeder to the other. We will next open the various motor or heating circuits, and if we still get a ring by the magneto we may ask, Isn't there still another normal channel for the current to pass in a circuit? as we are looking for normal causes before looking for abnormal. What about those two tell-tale wires leading back to the indicator or voltmeter in the dynamo room? As a voltmeter, it is connected across the polarities of the circuit; and so we next disconnect those wires at the instrument, and if we still get a ring, and no other normal channels or paths for the circuit are to be found, we look for crosses or trouble elsewhere.

Recollecting that this one feeder, to which the magneto is still connected, is connected with all the other feeders by means of the equaliser or helper wires, we will first disconnect the different feeders at the feeder ends, to cut out or disconnect all communication with their branch circuits, and then, by trying the magneto and getting no ring, should we conclude that the coast is clear so far as feeders and equaliser wires are concerned? No; not until we go back to the main bus-bars, and after disconnecting dynamos and instruments from the bus-bars, then connect or switch in the feeders, one by one, and if you get a ring from the magneto on connecting any of them back to the bus-bars again, you will then discover that though separately each feeder wire is properly connected to the like polarity of bus-bar, yet a mistake has been made by one or each lead of the equalising wire connecting the opposite instead of the same polarity of feeder wire, and thus making what is called a cross. Now connect branch wires at their feeder ends, and if all test out clear or free from any cross, we then test the entire wiring system to the lamps at once for a ground by connecting but one terminal of the magneto to both polarity wires of the feeder and the other terminal to a water or gas pipe as a common ground. If any contact or ground occurs at any point or ramification of the system, the bell will ring and tell the tale for the entire system at once—that there is a ground or "bug" somewhere. Then, by testing at feeder ends separately (isolating that feeder from the others) you proceed to separate the various circuits and test separately till identifying the grounded or, as the case may be, the crossed circuit through different (or double) grounds. Of course, if a wire is grounded on a fixture (chandelier), being insulated from the main pipe by an insulating joint, then that ground has to be located separately.

Now, when we have cleared all the grounds and crosses, if any, we may look to see if each individual light or outlet has proper and through electric service from the cut-out box at the feeder end. Proceeding to connect the magneto to feeder end and branch wires, we touch the wires at the outlets, or close the circuit in the lamp socket of the fixtures by inserting a metallic tool, and, by getting a ring from the magneto, we demonstrate a true circuit. If the magneto is beyond hearing distance, then allow the current from the magneto from the outlets or ends of the wires to pass through your thumb and finger, or put your finger end up in the lamp socket instead of the tool, and you will feel when the current is there. If a wire is broken so that you do not get current, then by grounding separately each wire at one end and by grounding the other end through the magneto, if it rings from but one wire and if you have connected to the proper wire at the cut-out box—then one of the wires is identified as broken, or is run to another or wrong outlet, but it may in like manner be so identified. If no gas or metallic piping is accessible to ground on, then the circuit may be completed through an extra wire provided as a temporary leg from the magneto to outlet.

In a case where a confusion of wires is found—as at a place for general distribution and thence concealed from view till appearing at the other ends or outlets—the quickest way to pair them off into circuits is to connect the terminals of the magneto to the outlet for light or motor (or with a flexible wire or cord to attaching plug) and to the screwed-in lamp socket in a fixture. Test with your fingers the ends of the wires in the cut-out box, and when you feel the current you know you have got the proper wires running to that outlet, so they may now be rightly connected to the proper cut-out if desired. If you have a live current (low tension) to test with at cut-out box, a very convenient method of identifying the wires and pairing them into circuits is to close the ends of the wires at one outlet at a time, as before, and then go to the cut-out box, connect with live current from fused cut-out one wire of lighting circuit, and then, with one hand on the other polarity of the live current wire (perhaps from off a main binding post of the unfused cut-out), take the other hand and feel the ends of the wire to be tested or identified (*i.e.*, close the circuit through your person). If you feel a current through your body you will know you have identified the circuit, or else another contact or cross is discovered instead, and you cannot thereby blow a fuse or a plug, as the resistance of your body protects the fuses and does not harm the person.

A very quick method of identifying grounded wires is also by feeling or closing the current through the hand as a testing instrument. If testing this way by use of alternating (secondary) live current, great care should be taken lest the transformer be defective and make yourself liable to get a dangerous shock from off the primary or high-tension wires, as you may get a shock (from a little dampness in the transformer), due to the primary wires being grounded outside. It must also be remembered that as some meters have a high resistance winding that contacts or closes the two polarity wires on which it is placed, it must not be mistaken for a cross on the lines in testing.

When cut-outs or fuse blocks are in place, but plugs or fuses are not in, before fusing them up, if live current is present in the cut-outs, close or bridge one plug or fuse opening, with a metallic tool, pliers or screwdriver, and by closing the other plug socket or contact screws, by sticking your finger into the plug socket or by spanning the open place for a fuse wire with thumb and finger, you can quickly find if there is a cross on any of the circuits and yet not burn out a fuse. In testing out a three-wire system, on dead wires, those intended for positive and negative wires may be

* *Western Electrician.*

bunched together to be attached to one terminal of magneto or a testing battery, and the neutral bunch of wires to the other. The reader is aware of the use of various galvanometers and the Wheatstone bridge for greater precision in locating faults. A voltmeter is also a very serviceable instrument in testing by use of live current, its greater or lesser deflections showing in a practical way the stronger or weaker grounds or crosses that occur through dampness, wet conduit tubes, &c.

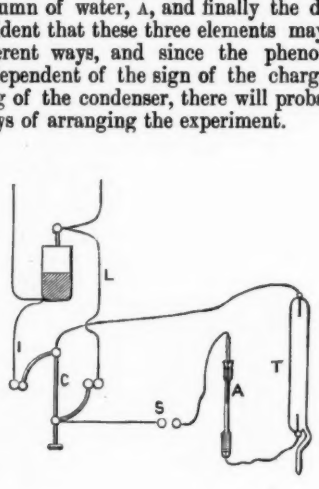
Mistakes sometimes occur by wiremen when they cut in two double-pole switches on a three-wire branch circuit from two (one way) branch cut-outs, as the two adjacent terminals in two neighbouring cut-outs are of opposite polarity and by mistake they use them, or try to, as a neutral wire, and hence a cross occurs. Sometimes the wires from different cut-outs supply one fixture, and by mistake are connected so at the switches that one polarity from each cut-out passes through one double pole switch and the other polarity through the other switch, so that one switch turns on no lights, but the second one turns on all, or *vice versâ*.

RECENT EXPERIMENTS WITH THE GLOBULAR DISCHARGE.

(*Continued from page* 436.)

The globular discharge is, of course, not the only luminous phenomenon that may be observed in the vacuum tube, and Righi has made experiments to determine how the different forms of discharge successively present themselves, with the view chiefly of establishing what conditions are favourable for the production of the globular discharge.

Other things being equal, the appearance of the different forms of discharge in the tube depends on the order in which the apparatus is arranged in the circuit. In the arrangement shown in fig. 1 we have, starting from one of the coatings of the condenser, first the exciter (the spark gap), S, then the column of water, A, and finally the discharge tube, T. It is evident that these three elements may be arranged in six different ways, and since the phenomena are not *a priori*, independent of the sign of the charge of the insulated coating of the condenser, there will probably be twelve different ways of arranging the experiment.



Starting with the arrangement, S, A, T, let it be supposed that the insulated coating is positive, that the explosive distance, d, at the exciter goes on increasing gradually from zero, that the column of liquid has a mean value, *i.e.*, about 20 cm. in length, and 1 cm. in breadth, and finally, that the discharge tube contains nitrogen.

When $d = 0$, there will be an apparently continuous passage of electricity through the tube, and the tranquil luminosity will be seen on the electrodes, which is characteristic of this form of discharge. If the balls of the exciter are then slightly separated to a distance not exceeding 1 mm., the aspect of the discharge in the tube does not perceptibly change. Between the balls of the exciter a spark is seen, which appears continuous, and produces a very sharp hissing sound.

If the distance, d, is still further increased, the discontinuity of the phenomenon becomes visible. Small sparks strike across between the balls of the exciter, at intervals which become steadily smaller, till the discharge forms a continuous luminosity, accompanied by the usual hissing, and which may last some seconds. These discharges have the appearance of a spark much less luminous at the middle than at the two ends; they appear to consist of two conical luminosities with their bases resting on the spheres. As long as this hissing spark persists at the exciter, the dazzling discharge can be observed on the electrodes of the tube. As soon as this ceases, the same succession of phenomena reproduce themselves.

If d is considerably increased, say, to 0·8 cm., the phenomenon changes its appearance; instead of the dazzling discharge, the globular discharge forms itself on the positive electrode of the tube. A further increase of the explosive distance, d, produces, instead of a single luminous mass, two, or several of these discharges, which detach themselves successively from the positive electrode; in other words, the charge from being simple becomes compound.

If these experiments are repeated with different resistances in the circuit, or with different pressures of the gas, the results remain fundamentally the same; but the luminous masses have different forms, dimensions, and velocities, and the values of d, for which the globular discharge replaces the dazzling discharge, are different. For instance, if the resistance is much smaller, the value of d, at which the globular discharge makes its appearance, is much less than before, and the time between two globular discharges diminishes also. This interval of time may become equal to, or less than a second; when it is very faint, a peculiar kind of undulation or pulsation may be observed in the luminous mass.

It ought to be noted, also, that when d is a little less than the value necessary to produce the globular discharge, and when the liquid resistance is rather small, the tuft discharge is sometimes observed in place of the dazzling discharge, especially upon the positive electrode. However, the tuft discharge is always slightly developed, although it preponderates when other arrangements, such as S, T, A, are adopted, instead of S, A, T.

The two experimental arrangements, S, A, T, and S, T, A, constitute, in some respects, two extreme cases, since with the former the globular discharge, and with the latter the stratified discharge, is easily obtained. The other possible arrangements give similar or intermediate results. The following are some of the conclusions to which they lead:—

1. The stratified discharge is produced in preference to the globular discharge when the discharge tube is put in that part of the circuit which communicates directly with the coating of the condenser between the exciter and the liquid resistance, especially when the exciter is next the positive coating. In the other cases, the globular discharge is produced by preference.

2. The values of the potential necessary, in any case, for the production of the discharge, depend equally on the explosive distance, d, and on the order in which the apparatus are placed in the circuit. Thus, although the place occupied by the liquid resistance has no influence in this respect, the potential ought to be more elevated than in the other cases, when the tube is between the exciter and the insulated coating of the condenser.

3. When the tube is between the exciter and the insulated coating, the potential necessary to produce the globular discharge is less than with the other arrangements. It follows from this, that the explosive distance at the exciter necessary for the production of the globular discharge is then very small.

The first conclusion shows that to obtain the globular discharge, and avoid the stratified discharge, it is necessary to guard against placing the tube between the exciter and the column of liquid.

This is why, in his recent researches, Righi has adopted the experimental arrangement shown in fig. 1. From the coatings of the condenser proceed two conductors, I and L, which are connected to the inverter, C. From this proceed two other conductors which form the discharge circuit, in which is intercalated the exciter, S, the liquid resistance, A, and the discharge tube, T. The arrangement is then S, A, T, or T, A, S. By means of the inverter, the lower electrode of the discharge tube, T, which is placed vertical, can be made positive or negative at will. The positive coating can thus be placed on the same side as S, or on the same side as T.

Unless the contrary is specified, the positive coating is considered to be connected directly with exciter, S.

As will be seen further on, the phenomena are somewhat different when other gases than nitrogen are used. It will be found that in gases in which the globular discharge is produced with difficulty, it can only be produced by the most effective arrangement, viz, S, A, T, while other arrangements give the stratified discharge only.

After studying the different arrangements of the experiment, Righi proceeded to investigate whether there was any close relation between the globular discharge and the stratified discharge.

These two forms of discharge have evidently some characters in common. In fact, in certain cases, the stratifications are possessed of movement in Geissler tubes, and appear as if they emanated from the positive electrode and travelled towards the negative electrode, exactly like the luminous mass obtained with the discharge of a large condenser.

It is natural, therefore, to suppose that each luminous mass forming part of the globular discharge is nothing but one of the striæ of the stratified discharge, and that, consequently, it will be possible to pass gradually from one to the other, by gradually increasing the pressure of the gas from the low value it has when the first form of discharge is produced to the value of 1 to 8 cm., which it attains when the second form is produced.

However, this is what has been observed with a tube of ordinary dimensions containing oxygen at an initial pressure of 0·018 mm. At this low pressure the discharge of the condenser is sharply stratified. If $d = 0$, *i.e.*, if the two balls of the exciter are in contact, a continuous luminous phenomenon is observed in the tube. There are seven or eight fixed and equidistant luminous bands, the luminous intensity of which is less as the resistance introduced into circuit is greater.

When a spark gap is introduced into the circuit by means of the exciter, sparks are obtained at intervals which are longer or shorter, according as the sparks are longer or shorter. At each discharge a luminous column, sharply stratified, is produced in the tube.

If a prolonged discharge is produced, that is to say, if the spark gap is suddenly closed, a luminous stratified column is still produced, but the stratifications are in much greater number than when $d = 0$. In the meantime, the stratifications retire slowly towards the positive electrode, where they disappear one by one, till their number becomes equal to that which is obtained when $d = 0$. In all cases the colour of the discharge at those low pressures is light blue.

If the pressure of the nitrogen is next increased by allowing more gas to enter the tube in successive small quantities, by a specially designed cock,* the phenomena are modified as follows:—First of all, the light of the discharge changes colour; it becomes rose coloured, and tends by degrees to take the red tint of the globular discharge in nitrogen. Moreover, the number of the stratifications increases, and their separation becomes less and less distinct. For instance, at the pressure of 0·118 mm., the stratifications, when $d = 0$, are 12 in number.

If at this pressure a prolonged discharge is produced, the number of stratifications increase in the first few instants after its commencement, but finally the number becomes 12 as before. At first some new striæ can be seen emanating from the anode; but directly afterwards a retrograde movement is noted, accompanied by the disappearance of some of the striæ near the positive electrode. This retrograde movement continues till only 12 immovable striæ are left in the tube.

The striæ are still sufficiently distinct at a pressure of 0·118 mm.; but at the pressure of 0·24 mm., they are already very diffuse, and difficult to count, not only because their number is very considerable, but because the difference between the maxima and minima intensities has become very small; also, the stratifications are no longer fixed, but appear to oscillate rapidly and irregularly in the direction of the axis of the tube. It is only by introducing a spark in air, or by using the prolonged discharge, that the striæ can be made momentarily distinct, more especially those furthest from the positive electrode.

* Men della R. Acc. di Bologna, Serie V., t. III., p. 119.

At higher pressures, at 1 mm., for example, it is no longer possible to see the striæ, even in the revolving mirror, and the luminous column appears continuous. On augmenting the pressure still further, the discharge concentrates itself in the axis of the tube, and stretches itself always more and more towards the cathode. When a spark is introduced into the circuit, the explosive and band form of discharge begins to appear; when the pressure is about 5 mm., the luminous mass, at first large and diffuse, then smaller and more luminous, begins to appear.

The speed with which it detaches itself from the positive electrode goes on diminishing, while the time of stoppage which precedes its disappearance diminishes. Finally, at a pressure of 20 to 25 mm., it has the minimum speed of translation, and remains attached to the electrode for a short time.

It is evident, therefore, when the globular discharge begins to appear as a consequence of gradual increase of the pressure, all the phenomena of stratification have ceased some time.

The observations, with gradually increasing pressures, have been made with many other gases besides nitrogen, and in all cases it has been found that stratification and the globular discharge are quite distinct. It is possible, on the contrary, to recognise a certain continuity between the stratified discharge and the band discharge. In fact, when the discharge is examined under increasing pressures, in a gas such as oxygen, in which the globular discharge cannot be produced, a gradual transformation of the stratified into the band discharge can be observed. The positive luminous column, which at first is distinctly stratified, and occupies the whole section of the tube, concentrates itself gradually in the axis, while the stratifications increase in number, and become always less and less distinct, till at last they are no more discernible. The stratified column is thus transformed into a luminous band, which, in its turn, can be transformed into an ordinary spark when the gap, d, is increased, or the resistance diminished.

(*To be continued.*)

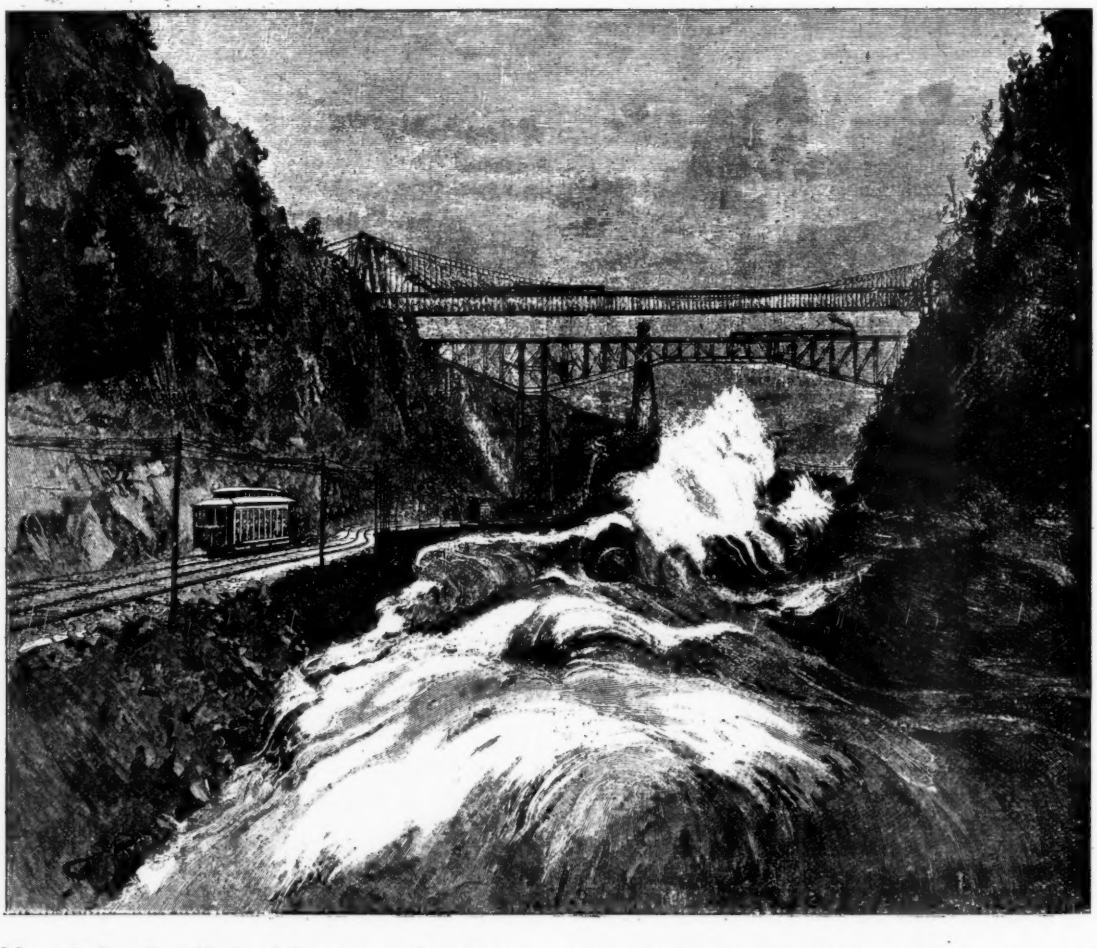
THE GORGE ROAD AT NIAGARA FALLS.

The traveller in Switzerland cannot fail to be impressed by the engineering enterprise expended in catering to the travelling public. Even the regular railroad routes are made subservient to the demands of the tourist. The St. Gothard Pass, which is the locus of the most wonderful piece of railroad engineering in the world, is crossed by regular trains, but special observation cars are used, to enable the surpassing wonders of the route to be seen by the passengers. Everywhere throughout the region the same story is told. Mountain railways, either cog-rail or cable traction system, are found everywhere. Some are operated by electricity derived from the neighbouring falls. Others are operated by steam locomotives which run on the level without cog rails, and which on the steep grades engage with the cog rails until the ascent is mastered. Thousands of people carry with them no grander memory of Switzerland than that afforded by the trip up the Grundelwald railroad, where the glories of the Moench, Eiger, and Jungfrau are seen at close quarters, and where the thunder of avalanches is repeatedly heard, and often the descent of the great snowy cataract from the sides of the Jungfrau is witnessed.

In the United States, says the *Scientific American*, it seems as if we were a little remiss in making provision for lovers of natural beauty. Show places we have in abundance, but efforts to properly develop them seem wanting. The dedication of the old switchback road at Mauch Chunk, Pa., to pleasure trips and the building of the cog-rail road up Mount Washington, N.H., were the earliest efforts of any moment in this country in the direction indicated. In our present issue we illustrate another, which is designed to prove one of the greatest attractions of Niagara Falls. It is the Gorge Railroad.

The lover of Niagara has two places which are particularly dear to him. One is the wild scene above Goat Island, the rapids above the Falls. Below them is the other scene, the Great Gorge Rapids, sometimes termed the worst piece

of water in the world, the scene of many exploits, or attempts at exploits, from the adventurous voyage of the old steamer, the *Maid of the Mist*, through its angry waves, to the trips in barrels and with life preservers, or even unassisted, of later adventurers. The Gorge Electric Railroad, operated by the Niagara Falls and Lewiston Railroad Company, is a tribute to the scenery of the Lower Niagara River, and is a unique and interesting enterprise which will attract the admiration of many travellers. It is operated in connection with the hotel and observation tower, which have been erected by the same company in the village of Niagara Falls, near the State Reservation. From this tower a view of the entire area is obtained, and the route of the winding gorge road can be traced as it descends the cliffs. Starting from the hotel, the road runs through the streets and out into the country, until a point about a half mile above the cantilever bridge on the edge of the cliffs is reached. Here the descent begins, and with a maximum grade of 3 per cent. the track runs down the sides of the cliff toward the great rapids. The lower



level is reached a short distance below the cantilever bridge, and thence the road winds along the foot of the cliffs 20 feet above the usual water level.

The illustration shows the scene at the rapids near the point where the river level of the road begins. Hence the rapids are in their wildest commotion. The great volume of water which has come over the falls is crowded and forced through a narrow space. The rate of the current in places is put as high as 30 miles an hour, but it forms numerous eddies and counter-currents, so that its average is far less than that. As the trolley cars run along its brink, it is interesting to watch the logs which sometimes are seen almost keeping up with the electric cars. At the place shown the spray flies far and wide, sometimes falling upon the cars. About this point the water in the centre of the rapids sometimes is 30 feet higher than that at the sides. A very curious feature is the formation and maintenance of almost stationary waves.

A mass of water will be seen forming a wave whose contour will hardly change. In the illustration the long descent of the road is shown, and the car is seen entering upon its course through the gorge. At this point the line is comparatively straight.

Visitors to Niagara will remember the somewhat confusing number of elevators by which the rapids were reached from the vicinity of the Suspension Bridge. Now the elevators have been stopped, with the exception of one, which will probably be maintained in operation for some time to come. The sketch is taken near the foot of this, the Buttery elevator.

For about a mile the rapids continue, when the river opens up and bends to the right, forming on the left a species of bay, into which the waters penetrate with a slow rotary motion, forming the celebrated whirlpool. The view at this point is peculiarly attractive. The cliffs rise some two or three hundred feet, and are darkly wooded, and the winding course of the road along the bank opposite the whirlpool gives a charming prospect. Without losing interest, the view now becomes more quiet, the river in its lower rapids being at least comparatively tranquil. A short distance below the whirlpool a monumental shaped rock stands on the outer side of the track, a conspicuous object, termed Giant Rock. On the right of the road is the Devil's Hole, a cave and gorge which was seen by La Salle in 1678, and which on September 14th, 1763, was the scene of a fearful massacre of a company of English soldiers by the Seneca Indians. During the construction of the road relics of the massacre—bayonets, buttons, and equipments—were found in considerable number.

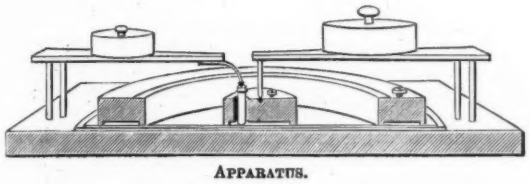
As Lewiston is approached the cars pass under the ruins of the old suspension bridge, the first one that ever spanned the river, and, in its day, the largest in the world. It was begun in 1848, and finished in 1850. In 1863 it was wrecked, and its ruins have ever since remained in partial suspension above the now placid waters of the river.

The entire length of the road, from Niagara Falls to Lewiston, is about 7 miles. Each car has two 50 H.P.

Westinghouse motors and electric heaters. The power is now supplied by the Niagara Falls Hydraulic Power and Manufacturing Company, utilising the water from the Schellkopf surface canal at 210 feet head. Two Westinghouse 50 H.P. generators supply the current at 500 volts potential. The line is laid with 60 lbs. steel rails, double-tracked throughout with trolley wire of 00 gauge. With the exception of the descent from the high land to the river, the maximum grade is 1½ per cent. The road is operated under the superintendence of Mr. J. R. Brooks. The chief engineer is Mr. G. H. Ricker.

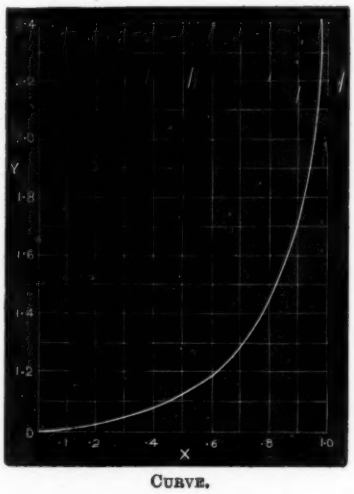
THE CAPACITY AND RESISTANCE OF A CORE WITH ECCENTRIC CONDUCTOR.

The experimental determination of this and kindred problems is very easily attacked by measuring the resistance of a thin metallic sheet stretched under electrodes of the required form; the sheet will represent the dielectric, the specific resistance (or specific inductive capacity) of which will be represented by the resistance (or conductance) of the sheet between the opposite sides of a square of any size; while the one electrode will represent the section of the conductor, and the other the external conducting surface.



Apparatus.

The following determinations were made with an external electrode formed of a copper ring about 17 mm. square in section, and with an internal diameter of 118 mm.: the internal electrode being a thick copper disc of such a diameter that its ratio to that of the external electrode represented D/d of the core in question.



Curve.

Very good results can be obtained with tin foil, but this material is not durable enough, and platinum, or one of its alloys, will be found more suitable both as regards higher resistance and durability. The only precaution requisite is to see that good contact is made all round the edge of each electrode; the best means of securing this, that I have found, is to place between the foil and the board on which the external electrode is suitably clamped, one thickness of wash-leather surmounted by thin paper. A fiducial line cut on the upper surface of the external electrode serves for determining the exact position of the internal electrode, and this can be pressed down and held in position by a species of tripod on which weights can be placed, one of the legs resting on the centre point of the internal electrode, and the two others standing clear outside the external electrode. These two electrodes are connected by flexible wires to the "current contacts" of a low resistance bridge; while the "potential contacts" will be connected, one to any part of the foil projecting outside the ring, and the other to a small rod which can be passed through an insulated eccentric hole in the internal electrode, and thus is secured direct contact with the foil. Both electrodes are recessed on their lower surfaces, so as to secure good contact at their edges. The rough sketch will explain the general arrangement.

Subjoined is a Table giving the mean readings on a number of different foils, and the last column is calculated from the formula

$$1 - \log_{10}\left\{1 - \left(\frac{d}{R - r}\right)^2\right\},$$

which is the curve traced in the diagram; the ordinate being this quantity, and the abscissa $d/(R - r)$, where R is the inner radius of the external electrode, r that of the internal electrode, and d the distance of their centres.

A good check on the evenness of the foil is afforded by the calculation from $\log R/r$, and the resistance in the concentric position of the specific resistance of the foil, and comparing with the resistance determined from a strip with parallel sides. This, for the foil given in the Table, was ·01404 ohm per square.

I have in this way also determined the effect of various stranded conductors in increasing the capacity of a core as compared with a solid conductor of the same weight, *e.g.*, in the case of a core of the smallest ratio given in the Table, which is about that of Atlantic cable cores, a seven strand increased the capacity 5·7 per cent., and a 12 strand (11 round 1) 4·5 per cent., all the conductors being of the same weight per nautical mile.

X $\frac{d}{R - r}$	Ratio of capacity to that of concentric core, R = 59.			Y
	r = 23·25.	r = 12·5.	r = 5·1.	
0	1·	1·	1·	1·
·2	1·021	1·020	1·018	1·0177
·4	1·073	1·073	1·078	1·0757
·5	1·124	1·118	1·120	1·1249
·6	1·197	1·192	1·180	1·1938
·7	1·308	1·300	1·285	1·2924
·8	1·466	1·470	1·431	1·4437
·9	1·750	1·800	1·773	1·7212
·95	1·950	2·050	2·140	2·0110
Log R/r	·404	·674	1·063	
Resistance ...	·00209	·00347	·00545	
Specific	·01411	·01405	·01399	

F. J.

ECONOMICAL RESULTS IN MODERN ISOLATED ARC LIGHTING.

In a paper read before one of the American Institutions very recently, Mr. F. E. Drake, says *Electricity* of New York, remarked that much has been said and written about economies which might be practised in isolated lighting plants, but as yet very little actual data has been presented to the public bearing upon the cost of operating an isolated arc lighting plant and showing what might be done with modern machinery if properly installed and then operated by careful and competent hands.

The plant which Mr. Drake specially took for the subject of his paper is that owned by J. L. Hudson, the successful clothier, and lights his handsome store in Detroit, Mich. It was purchased in 1891 and installed under the direction and advice of well known authorities on electrical and mechanical engineering.

	For 4 years and 4 months.	For 1895.
Arc lamp hours	1,527,538	351,658
Arc kw. hours	763,769	175,829
Incandescent lamp hours ...	2,735,766	1,038,836
Incandescent kw. hours ...	150,467	57,136
Cost per kw. hour		$·03145

In reviewing the cost per lamp for 1895 one will note that the three chief items of expense are $13.79 for labour, $9.71

for fuel and $2.75 for carbons, figures which are quite phenomenal when the output is considered. Perhaps the most startling figures shown are those giving the extremely low cost of dynamo and lamp repairs. In 1895 the total of dynamo repairs, including brushes, was $30.85, or $5.14 per dynamo. Can a better showing be hoped for? The 205 arc lamps had repairs to the extent of $85.90, or 42 cents per lamp, which covered all globe breakage. These results are well worthy of emulation and show conclusively that the oft-repeated cry of "economy" has been heard and heeded by the owner and operators of this plant.

Detailed Cost—205 Arc and 200 Incandescent Lamps in the J. L. Hudson Building, Detroit.

	For entire period of 4 years and 4 months.	For the year 1895.	Cost per lamp, 1895.
Coal	$8,834.19	$2,185 70	$9.71
Carbons	2,979.31	618 00	2.75
Labour	14,012.09	3,102.43	13.79
Water for boilers	452.09	86.00	.38
Soap, soda, mops and brooms...	128.76	12.35	.06
Cylinder, dynamo, and engine oil	1,004.28	181.74	.81
White waste	165.15	29.82	.13
Incandescent lamp renewals ...	807.85	110.33	.49
Incandescent wiring	422.50	...	...
Repairs on boilers and furnaces	794.66	311.33	1.38
Repairs on clutches and shafting	41.85	8.31	.03
Repairs and packing for engines	110.26	45.36	.20
Repairs on 205 arc lamps ...	163.02	85.90	.38
Repairs on 6 dynamos, including brushes	*335.44	30.85	.14
10 per cent. depreciation on boilers ($2,000)	866.66	200.00	.88
2 per cent. depreciation on engines and shafting ($4,000)	346.66	80.00	.36
4 per cent. interest on $6,000 ...	1,000.00	240.00	1.07
Total	$32,464.77	$7,328.12	$32.56

* $200 of this sum expended in an exchange. Average in last column on basis of 225 arcs.

THE APPLICATION OF ALTERNATING CURRENTS TO ELECTRIC RAILWAYS.

In an article by Edwin J. Houston, Ph.D., and A. E. Kennelly, Sc.D., in the *Electric Railway Gazette*, the authors say:

Existing electric railways are capable of being arranged in two different classes, namely:

(1.) Ordinary street railways provided with either overhead or underground trolleys.

(2.) High-speed, long distance, or interurban electric railways.

It would appear that no advantage is to be gained for street railways by the use of alternating currents beyond the elimination of all practical danger from electrolysis. Damage to buried pipes by electrolysis can, however, be so readily avoided with the continuous current systems now in use that it is unnecessary to employ alternating current systems on this account. Moreover, other things being equal, the danger of a shock from a given pressure of alternating current at ordinary frequencies is known to be greater than the danger of a shock from an equal effective continuous current pressure; and then, too, the multiphase motor requires, at least, two trolley wires. The introduction of the alternating current on street railway systems would, therefore, involve a greater personal danger from shocks to all who handle the wires, besides necessitating a reversion to the double trolley.

For high speed long distance electric railways the conditions are usually different. Here the electric pressure has to be increased in order to reduce the cost of conductors. Moreover, in a permanent system of conductors there is less objection to a double trolley.

When the electric pressure is high it is well known that difficulties exist in checking the current, which first passes through the motors on starting them from rest, so that large and cumbrous rheostats, or "diverters," have to be employed for this purpose. With alternating currents and alternating current multiphase motors it is a simple matter to check these currents by the use of reactance coils, employing iron cores capable of insertion and withdrawal. Consequently, by this means the facility of handling high pressures is greatly increased. The motors, too, become simplified, since they require no commutator, and the whole apparatus reduces itself to the simplest conditions.

It appears to us, therefore, that there is a wide field for the introduction of alternating current electric railway propulsion on interurban, high pressure and high speed electric railways, but that the advantages do not appear to be possessed by ordinary street railways.

ARC LAMP POSTS.

Many and wonderful are the designs which have been adopted for arc lamp standards, but the vast majority of them have been either eyesores to the artist, or impossible monstrosities to the engineer. Some few may perhaps be accepted as passable, but they are for the greater part a sorry lot indeed. Some are too short, others too tall; some are too light, others too heavy; some bend with the wind, others would not bow to anything less than an earthquake; some permit too dazzling a light, others hide theirs as under many bushels. It is problematical whether it is in the mind of man to design a standard and lantern which will meet all the lighting-engineer's requirements, to say nothing of the fastidiousness of the artist. The difficulty is largely due to the fact that mechanism is essential to an arc lamp, and that in cases where the light is to be projected directly downwards, it is of the utmost importance to interpose the smallest possible obstruction to the rays emanating from the carbon points. It follows that the striking coil and regulating gear cannot be fixed to the top of the lamp post with the carbons above, but must be placed above the arc, and herein lies the trouble. When the lamps are supported on the top of a simple vertical standard, after the manner of a gas lamp post, a substantial frame has to be employed in order to provide sufficient mechanical strength to carry the gear work of the lamp which usually weighs a quarter-of-a-hundredweight or more. This accounts to a great extent for the unsightliness of the lamps in the City of London.

One of the most satisfactory forms of this class of lamp post, so far as appearance is concerned, is that in which a pair of fixed substantial vertical rods extending above the standard carries the coils and mechanism, these rods and the carbons being enclosed in the usual opal shade. To our mind the worst of this class of arc standard is that in which a huge U-shaped casting extending outside the globe is employed to carry the lamp.

In another class of lamp standard the post terminates in a more or less graceful curve, so that the lamp hangs from its end over the roadway. In such cases, however, there is a deep shadow cast across the pavement by the post, and the larger the post and the nearer the lamp to the post, the greater, of course, is the shadow. In the event of the lamp being hung over the pavement instead of the roadway, the matter is perhaps more troublesome, the shadow being in such cases cast across the roadway. Obviously the hanging lamp should be supported by the slimmest possible standard, and the curvature of the bend should be as great as possible. But both these *desiderata* are directly opposed to the ordinary doctrines of mechanical construction which require, of course, that the diameter and strength of the post should be considerable, and the curvature of the bend a minimum. The Chicago West Park Board have recently made contracts for 1,000 supports of this class to the specification of their engineer. This specification has been published in the columns of the *Chicago Electrical Journal*, but, although our transatlantic contemporary has, apparently, been greatly impressed by the

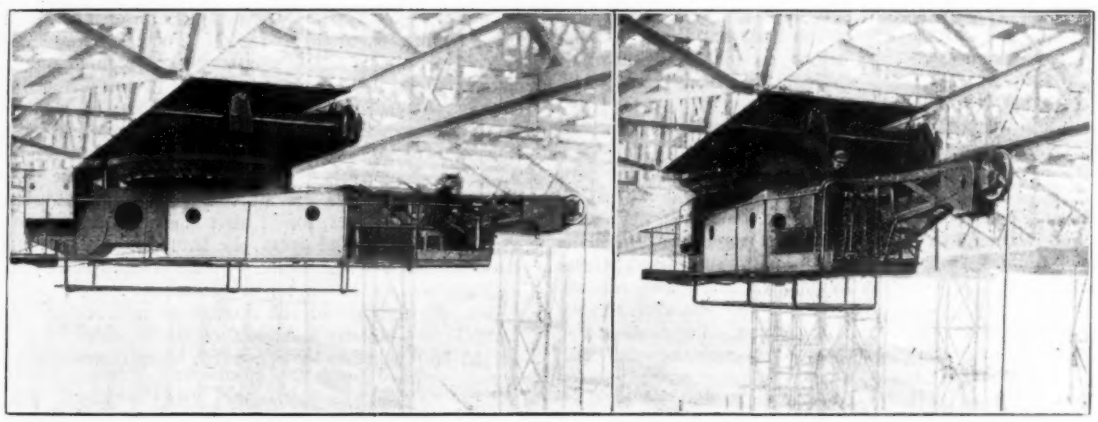
design, we fear that it fails to comply with the majority of the requirements. In view of the fact that we are not professed artists, we need say no more about its appearance than that we should not like to see it adopted in England. Its curves are not pretty; they are not, to our eyes, lines of beauty, and even those lines, which in the drawing are straight, are not likely to long remain so in the post; but these are, perhaps, only personal objections. The disadvantages, from an engineering point of view, are more serious. The standard is to be made in three parts, the lowest being a tubular iron casting 11 feet long, 5 feet of which will be buried. Fitting into this is a second section "made of clear straight-grained Georgia pine or Norway pine . . . . turned up round and smooth . . . . properly treated with creosote or other acceptable wood preservative . . . . 18 feet being the maximum length." Surmounting this is a "long curved portion . . . . made of a 2-inch galvanised iron gas barrel" to which a cast-iron scroll must be attached by means of a wrought-iron ring and bolt. On the basis of the figures mentioned, the arc will be 26 feet or more above the ground, but the diameters of the various parts of the standard are not mentioned. The conductors are to be carried up through the lamp post, a 1¼-inch hole being bored through the wooden section; but no provision is made for lowering the lamp for trimming purposes. The trimmer will, therefore, have to carry with him either a ladder some 35 feet in length, or some structure on wheels with a platform at a height of 20 feet. But the most serious objections are to the mechanical design. In the first place timber is, of course, weaker than iron, and the former to afford sufficient rigidity or mechanical strength, must be inconveniently large in diameter, in which case the lower iron portions, at least, must be unnecessarily heavy (the weight of this portion is specified to be within 5 per cent. of 1,000 lbs.). If, on the other hand, the iron is just sufficiently strong, the timber is too weak. Again, as the lamps are to be run on a high-pressure circuit, we view with the greatest apprehension the results of an abrasion of the insulating material on the conductor, or of any other fault which may develop, and raise the whole of the upper iron portion of the standard, insulated as it is from the ground by the creosoted wood section, to a high potential.

There is no doubt that under all circumstances the whole of an arc lamp post should be effectively connected to earth, so that any part of it might be touched, accidentally or otherwise, with impunity. It may be argued that a switch is provided to disconnect both wires before the trimmer ascends the ladder. It is quite within the range of possibility that the switch may be faulty, and so fail to entirely insulate the lamp circuit; or should the lamp be faulty and consequently not alight, the trimmer may neglect to use the switch. Further, it is sometimes necessary that he should inspect the lamp while it is burning, and it is too much to ask him to avoid touching the upper part of the post. It may, perhaps, be noticed that supposing every one of the 1,000 lamps to be trimmed daily, there are annually 365,000 chances for such an accident to happen, and we commend this matter to the serious attention of the engineer to the Chicago West Park Board; for it is conceivable that such a fault might easily occur, and under such circumstances as to give no warning whatever of its existence until the man touches the bend of the standard.

With regard to the question of durability we may remind our readers that composite poles were tried long since for telegraph purposes, but had to be abandoned.

ELECTRIC TRAVELLING CRANES.

We give below two photographic views of one of several overhead travelling cranes which have been working very successfully for the last nine months at the new shipbuilding sheds of Messrs. C. S. Swan & Hunter, at Wallsend-on-Tyne. The cranes, which were designed and built by Messrs. Clarke, Chapman & Co., Limited, are each driven by means of a 25 kilowatt motor at 110 volts, and each has a lifting capacity of three tons. Two sets are fitted in each shed where they are chiefly used for carrying beams, plates, frames, &c., at a height of 80 feet above the ground.



Electric Travelling Cranes.

A solenoid brake is attached to each crane for the purpose of stopping instantaneously.

CENTRAL STATION WORKING.

Another contribution to this series in the *Electrical World* is the work of Mr. H. W. Frund, and is concerned with the request made by the National Electric Light Association of America to be furnished with reports of a strictly engineering character of the mechanical efficiency of the various types of equipment in use in central stations, and he cites the painful fact that out of 2,344 stations in operation in the United States, the committee of data, in response to their request, only received reports from 24, and Mr. Frund attributes that regrettable fact to be partly due to the lack of proper engineering records being kept in the majority of central stations, and he suggests that the National Electric Light Association should instruct central station engineers in the rudiments of tabulating the results of the working of the station. He emphasises the importance of having distinct engineering data compiled as against the purely financial statements with which we are familiar in this country, and

which we venture to think are useless for the sake of comparison, because it is impossible to reduce the various statistics to a common basis. It is essential that proper engineering records should be kept perfectly distinct from financial operations, and a complete system should be available by which any undue waste can be immediately detected, as well as a check on the quantities provided each day for the generation of current.

Following Mr. H. W. Frund comes Mr. E. B. Newcombe, who, before describing some of the difficulties he experienced in connection with his alternating current supply, indulges in a little diversion in the shape of some experiences he had with statically charged paper and belts in a large paper mill connected to a continuous current supply. The incandescent lamps were found to be subject to violent agitation of the filaments when in the neighbourhood of highly statically charged belting or paper. By providing the simple remedy of two or three pointed wires put about the lamp, and connected to the socket in the manner of attaching a shade holder, and connecting the socket, if not otherwise grounded, to one wire of the circuit, an outlet was made for the discharge, and his troubles in this direction ceased. For reasons given later on, the mill was disconnected from the continuous current supply, and connected to an alternating supply, being fed by a bank of transformers. A more serious trouble then presented itself, which, it will be seen, Mr. Newcombe satisfactorily overcome.

The main circuits and feeders, both primary and secondary, ran parallel on the same cross arms and structures for a larger part of their length, and he found that in certain localities at the extreme end of the distributing mains, the lamps gave an unsteady light, which resembled the fluctuations which one experiences with a slack driving belt; but as these fluctuations only appeared at the extreme ends of the circuit, and were not general, it was concluded that induction was responsible for this effect.

The frequency of the fluctuations was found to depend on the relative speed of the two alternators. The waves of current, if not in phase, alternately matched and mismatched, much on the principle of two piano strings, nearly, but not quite, in unison, making a noticeable wave in the tone produced. A corresponding variation was also noticed in the humming of the alternators at the station. It was clearly evident that the induction did not take place in the primaries, because no commercial lights were affected, but was in the secondary mains, which carried a much heavier current. Believing this to be the cause, he lost no time in crossing all the secondary feed wires of one of the systems at about the middle of their length. This theory was found to be correct, as the trouble then ceased. In another quarter a similar trouble was experienced in the primaries of two circuits which ran for a considerable distance parallel to each other on the same cross arms, the two inner wires carrying a somewhat heavy current, while the two outside wires were lightly loaded, and complaints were received from the districts supplied by these mains of a trembling appearance in the lamps. Mr. Newcombe profited by the experience he had gained in the mill, and promptly crossed his wires about half way, and found the cure effectual.

Instances are not unknown where a low tension continuous current system has been put down, and when the limit of distribution, due to the fall in pressure at heavy loads, was reached, and recourse had to be made, in supplying the wider districts, to high tension currents. We can quite understand that this was what Mr. Newcombe experienced, and it is somewhat inexplicable to us that with the experience already gained by engineers in this country, some still should favour such a complication of apparatus which is inseparable in the combination of two systems of supply.

So successful was Mr. Newcombe's experience in lighting with alternators, that he affirms that had he to begin over again, he would discard entirely direct current apparatus. He does not charge direct current with being incapable of doing its work, but finds that had he employed a high tension system, we may say either continuous or alternating, at the start, combined with a low tension system of distribution, he would have been able to supply the whole district with a uniform type of plant. Instead of the limited area to which he was necessarily confined by his low tension three-wire system, he is now supplying current successfully at points six miles from the station.

THE INSTITUTION OF CIVIL ENGINEERS.

On Wednesday, the Institution of Civil Engineers entered on the third stage of its career. It was incorporated by Royal Charter on June 3rd, 1828, when it possessed 156 members, with Thomas Telford as president. The charter gave them power, *inter alia*, to possess a hall not exceeding in annual rental value £1,000. This first stage continued until August 3rd, 1887, when the membership having grown to 5,174 and the annual income to £19,945, a supplemental charter was granted empowering the Institution to possess a hall and lands to the annual rental value of £8,000. Under these extended powers, the new and handsome structure which now adorns Great George Street has been erected, but it has succeeded in coming into use only just before the expiration of stage 2.

Stage 3, which we have just entered, must be described at some length, but it may be easily summed up in three words —"Sir Benjamin Baker." If there had been no Firth of Forth, there would have been no Forth Bridge, and if there had been no Forth Bridge, there would be at this moment no President Baker, and the Institution would have been yet in its sins, wealthy but unregenerate (there is thus a curious but undeniable connection between the physical geography of Scotland and the constitution of the honourable and learned society which meets weekly at Great George Street); now all is changed. Sir Benjamin having risen to the enjoyment of the highest honour the profession can confer, with such rapidity that in one individual are combined the powers of a president and the feelings of a member, has used those powers, energised by those feelings, to redress certain grievances, under which members have been groaning and chafing these many years past, hoping against hope for the coming of Shadrach, Meshach, and Abednego, who should say to the council, "We will not serve thy gods, nor worship the golden image which thou hast set up"—but they came not. They could not face the fiery furnace of the council's displeasure. No one dreamt that Darius, in the person of Sir Benjamin Baker, would come either under the bridge or over the bridge, and from the throne of the presidential chair reform the constitution on lines of equity and justice.

Stated simply, the principal reforms are:—

1st. An increase in the number of members of council, from 20 to a possible maximum of 35, to admit of portions of the empire, other than London, being represented on the council.

2nd. An improvement in the method of making and presenting the nomination list of president, vice-presidents, and members of council, providing for the lapse of one month between nomination and election, and for the annual introduction of new blood.

3rd. The substitution of voting per post in lieu of voting by personal attendance, which in the past has placed the control of the Institution, so far as there was any control on the part of members, in the hands of the minority resident in London.

The council also takes power to include in their number in each year four past presidents. Previously, presidents, on passing the chair, have ceased to be members of council. That this new rule is a good one cannot be doubted, as it gives the council the benefit of the service of the best men, without permitting them by mere force of numbers to dominate the council.

In the history of the world, our various engineering societies are but the children of yesterday; their constitutions were originally evolved out of somebody's head, and the process of natural development has been slow and tedious, nevertheless they are gradually coming into line with modern requirements.

The council of the Institution of Civil Engineers is composed of men some of whom are members of council of other societies, three of them being members of council of the Institution of Electrical Engineers, and it will be interesting to note whether the new leaven of the parent society will be transmitted through them to others, until all are leavened.

Electric Clocks.—The Dundee Council Works Committee is considering a proposal to regulate the various public clocks of the city electrically.

CORRESPONDENCE.

Wiring Table.

I enclose a copy of an old "wiring table," which I have used during the past three or four years. It might be useful to your readers to print an extract from it. There are many wires named on it which are not generally used now. The 26 columns marked with * would be sufficient for general purposes. This is a reply to your note after Midland Electrical Company's letter.

A. F. Scott, *A.M.I.E.E.*

Amperes per sq. in.	1/20	1/19	1/18	1/17	1/16	1/15	1/14	1/13	1/12	3/25	3/23	3/22	7/25	7/23	7/22	7/20	7/19	7/18	7/17
1,000	1·0	1·2	1·8	2·4	3·2	4·0	5·0	6·6	8·5	0·9	1·4	1·9	2·2	3·2	4·4	7·2	8·9	12·8	17·4
750	0·7	0·9	1·3	1·8	2·4	3·0	3·7	4·9	6·4	0·7	1·0	1·4	1·6	2·4	3·3	5·4	6·7	9·6	13·0
500	0·5	0·6	0·9	1·2	1·6	2·0	2·5	3·3	4·2	0·4	0·7	0·9	1·1	1·6	2·2	3·6	4·4	6·4	8·7
400	0·4	0·5	0·7	0·9	1·3	1·6	2·0	2·6	3·4	0·3	0·5	0·7	0·9	1·3	1·7	2·9	3·5	5·1	6·9
300	0·3	0·3	0·5	0·7	0·9	1·2	1·5	2·0	2·5	0·3	0·4	0·5	0·6	0·9	1·3	2·1	2·6	3·8	5·2
250	0·2	0·3	0·4	0·6	0·8	1·	1·2	1·6	2·1	0·2	0·3	0·5	0·5	0·8	1·1	1·8	2·2	3·2	4·3
200	0·2	0·2	0·3 *	0·5	0·6 *	0·8	1·0	1·3	1·7	0·2 *	0·3 *	0·4 *	0·4	0·6 *	0·9 *	1·4 *	1·8 *	2·5 *	3·5

Amperes per sq. in.	7/16	7/15	7/14	19/20	19/19	19/18	19/17	19/16	19/15	19/14	19/13	19/12	37/16	37/15	37/14	37/13	37/12	61/13	61/12
1,000	22·9	28·9	35·6	19·8	24·3	34·9	47·9	62·4	79·9	97·3	128	165	122	154	191	351	322	416	532
750	17·2	21·7	26·7	14·8	18·2	26·2	35·9	46·8	59·9	73·0	96·1	123	91·4	116	143	189	241	312	399
500	11·4	14·4	17·8	9·9	12·1	17·4	23·9	31·2	39·9	48·6	64·1	82·3	60·9	77·0	95·4	126	161	208	266
400	9·1	11·5	14·2	7·9	9·7	13·9	19·1	24·9	31·9	38·9	51·2	65·9	48·7	61·6	76·3	101	129	166	213
300	6·9	8·7	10·7	5·9	7·3	10·5	14·4	18·7	24·0	29·2	38·4	49·4	36·6	46·2	57·2	75·5	96·5	125	160
250	5·7	7·2	8·9	4·9	6·1	8·7	12·0	15·6	20·0	24·3	32·0	41·2	30·5	38·5	47·7	62·9	80·4	104	133
200	4·6 *	5·8	7·1	3·9 *	4·8	7·0 *	9·6 *	12·5 *	16·0 *	19·4 *	25·6 *	32·9 *	24·4	30·8 *	38·2 *	50·3 *	64·3 *	83·2 *	106 *

Note.—Limiting distance for a loss of 2 volts at 1,000 amperes per square inch = 40 yards.
" " " " 750 " " = 52 "
" " " " 500 " " = 80 "
" " " " 250 " " = 160 "

1. Find the distance of the furthest lamp from the distributing board of any circuit; this determines the current density of that circuit as indicated above. Thus, for a distance of 40 yards, the circuit may be wired to 1,000 amperes per square inch, with maximum loss of 2 volts. For 52 yards the density should be 750 amperes per square inch, and so on.

2. For a length of cable from which current for a number of lamps is taken off uniformly, the mean value of the current may be taken, provided that in no part of the conductor the current density exceeds 1,000 amperes per square inch. The current density being fixed, look along the horizontal line referring to this density until the current is found. The size of wire or cable will be at the top of that column.

A. F. S.

June 22nd, 1892.

Traffic on the Bristol Tramway.

I give below some figures showing the difference in the carrying capacity between the horse and electric trams of Bristol; it may interest some of your readers who are interested in electric traction.

On Easter Monday we had a total of 90 cars and four omnibuses running, and the passengers carried numbered 103,600, as compared with 81,276 on the corresponding day last year, showing an increase of 22,384, of which the horse car lines contributed 5,231. On the electric section from Bristol to Kingswood we carried, with 12 motor and 12 trailer cars, 25,416, and fully 21,000 of the above travelled from 12 noon till 12 midnight.

W. Wood, *Chief Engineer.*

April 10th, 1896.

[The comparison between horse and electric traction seems slightly obscure.—Eds. Elec. Rev.]

Kamm's Telegraphic Typewriter.

I am afraid I cannot agree with the remarks in your last issue with reference to the above. Permit me a few words in answer to some of the criticisms.

I quite allow that it is slow in its action as compared with an ordinary typewriting machine, but it must be borne in mind that its proper function is as a printing telegraph. Compared with other printing telegraphs, it is even in its present form, I believe, very little behind any of them in point of speed, while the improvements which are now being introduced by the inventor promise to render its speed equal, if not superior, to that of any other instrument of the kind.

The comparison with the Hughes instrument made in the circular was, as the context clearly shows, not so much in respect of form or mechanism as of function, viz., of telegraphic type-printing. No reflection was made, or intended, on the Hughes instrument. On the contrary, it was explicitly stated that the Hughes instrument was the best known and most reliable, up to now, for the purpose of telegraphic type-printing; but it is claimed that the Kamm instrument has the advantage over the Hughes of being entirely electric and automatic, with the additional merit of being much lower in first cost.

As to your statement that you fail to see any superiority in Kamm's instrument over the other column-printers you mention, I am not aware that these latter possess the very distinctive merit of Kamm's instrument, viz., that it is a transmitter as well as a receiver. Taking this important fact into consideration, the instrument can, I submit, hardly be termed complicated, and, as regards its mechanism, it seems to me little, if at all, more complicated than an ordinary typewriter. As to its reliability, the printing of each letter is effected by means of an absolute synchronism without requiring adjustment of any kind. Surely this should render the instrument more reliable—not less, as you consider—than any other column printer. Indeed, this synchronising feature should place the system on the same footing as the Morse, as regards reliability, and certainly far ahead of any other column or tape printing machine.

Permit me to say that I think you would be doing the public, no less than the inventor and the electrical industry, a service by giving this ingenious machine, as you well describe it, a further trial. Without going so far as to advocate that its use should be permitted in competition with Her Majesty's telegraph service, I believe that it is worthy of the serious attention of the Post Office, by reason of the great convenience and undoubted advantages it holds out to the business community, to which, in the long run, every other consideration must bow.

W. Gentry Bingham.

Wolverhampton, *April 14th*, 1896.

Correction.—In Mr. Grimshaw's letter which appeared last week *re* "Error in the Design of Electrical Plant," two printer's errors occurred:—Line 11, "*saw*" mill should read *same* mill; last line, "*mar*" should read *meet*.

Dynamo Calculation.

I can quite sympathise with "Student," as I have so often met with people who were utterly perplexed by the pages of symbols and formulæ to be found in such works as S. P. Thompson's "Dynamo Electric Machinery," or Kapp's "Transmission of Power." In the design of small dynamos, many of the details herein discussed may, of course, be entirely left out of consideration. It is, however, next to impossible for a beginner to determine those which are and those which are not of importance. It was this consideration which led me to prepare some two years ago an article, entitled "An introduction to Dynamo Design," which appeared in the Electrical Review of February 23rd, 1894, p. 212. In this article, however, the subject is treated in an extremely rough manner, and is intended only for very small machines (the one therein considered being, if I remember right, of $\frac{1}{10}$-H.P. output). The design of a 24 kw. machine is, however, a very different matter, and would involve the consideration of innumerable details, which experience alone can dictate. I trust, however, that the article alluded to may serve to show roughly the method of procedure in every case, and for details as to sparking, &c., one of the numerous works on the subject of dynamos must be consulted. It should be borne in mind that the methods employed by all firms of dynamo builders are what might be described as trial and error methods, and the experience gained from foreign machines is turned to account. I fear, therefore, that "Student" will find it no easy task to design an even moderately efficient 24 kw. machine without such experience to guide him, and without completely mastering several of the formulæ which he describes as "useless to students."

Kenelm Edgcumbe.

Reading, *April 14th.*

The X Rays.

Will you kindly tell me (as a subscriber to your journal) if the alternating current from city mains (105 volts) can be used (of course, with transformer or resistance) with Rhumkorff coil for producing X rays. If so, what is the most suitable resistance to use?

X.

[A satisfactory result could not be obtained by working a Rhumkorff coil off an alternating current main, as the electrodes of the tube under such conditions become alternately anodic and cathodic, the alternating currents being of equal strength. With the contact-breaker of a coil, on the contrary, the induced current in the secondary is greater at the make than at the break, so that the anodic and cathodic effects are correspondingly unequal, which is what is required. The only satisfactory method of using alternating currents, so far as we are aware, is to transform up to, say, 20,000 volts, and then use a Tesla coil with Leyden jars. We believe that a number of Mr. A. A. Campbell Swinton's earlier photographs were taken with such an arrangement, but since the advent of the focus tubes he has abandoned it for continuous currents and the ordinary Rhumkorff coil, with contact breaker. We do not wish our correspondent to think that alternating currents cannot be used and made to give as good results as the continuous; it is possible that eventually they may do better, but for their application special tubes must be designed, and this would probably mean much experimental research. Mr. Campbell Swinton, indeed, has tried some specially constructed double-focus tubes for alternating currents, but the results have not been up to his expectations. If alternating current is the only supply available, we would suggest to our correspondent a small motor-generator, from which he could obtain continuous current.—Eds. Elec. Rev.]

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—The *London Gazette* contains notification to the effect that the application for discharge of George F. Rogers, electrical engineer, of 41, Maxilla Gardens, Notting Hill, and 5, Great Winchester Street, E.C., will be heard at Bankruptcy Buildings on April 28th at 11 a.m.

Liquidation Notices.—The *London Gazette* announces the release, dated April 2nd, of Mr. G. S. Barnes, of 33, Carey Street, W.C., the liquidator of the Ford-Lloyd Manufacturing Company, of 2 and 4, Phœnix Place, Mount Pleasant, London, W.C.

A general meeting of the members of the Domestic Telephone Company, Limited, is to be held on May 14th, at 12 o'clock noon, at 24, Fulham Road, London, S.W., to hear an account of the winding-up proceedings.

Catalogues.—A neat little catalogue which the Sunbeam Lamp Company, Limited, has issued of electric incandescent lamps, contains a number of photographic views of the various departments at the works, as well as a number of illustrations of the different kinds of lamps made there. High voltage, conical, spirola, fluted, tubular, battery, and other lamps are shown, and prices given.

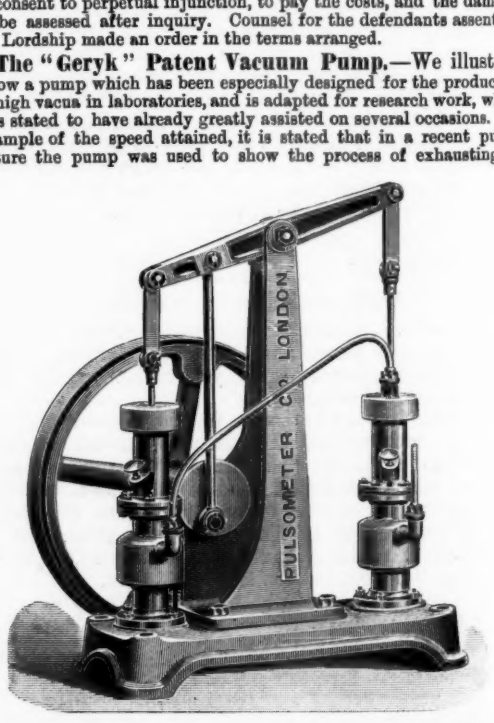
Messrs. Williamson & Joseph have brought out a fifth edition of their catalogue of electrical supplies, bound in bright red covers. We cannot spare space to enumerate the great number of articles which are shown, but, as might be expected, the following articles, among others, are described and illustrated:—Main and distributing switchboards, switches and cut-outs of various types, measuring and testing instruments, ceiling roses, wall sockets, china and other decorative fittings, lampholders, pendants, brackets, and a host of accessories used in connection with electric lighting and power installation work. The catalogue is well illustrated, and should be useful to the trade. Nearly every article is priced.

Coventry Electrical Engineering Company.—At the Coventry County Court on 14th inst., before his Honour, Judge Ingham, Mr. Walter Browett applied on behalf of the Northern Electric Wire Company, of Sedburgh Mills, Halifax, electric wire and cable manufacturers, for the withdrawal of a petition for the compulsory winding up of the Coventry Electrical Engineering Company. Terms had been, he said, agreed upon between the debenture holders and the petitioning creditors. Mr. Maddocks for the debenture holders, and Mr. Wilks for the company, and the liquidator (Mr. S. T. Peirson), consented to the application, which his Honour granted.

Green's Economiser.—The Sunderland Corporation have placed an order with Messrs. E. Green & Son, Limited, for one of their patent fuel economisers for the extensions at the Electric Light Station. This firm also has contracts in hand for the supply of their economisers to the electric installations at Blackpool, Bury, and Croydon.

Lumière v. The Anglo-Continental Phonograph Company.—This was an action for an injunction to restrain the defendants from selling or offering for sale cinematographes not of the manufacture of the plaintiffs as or for those manufactured by the plaintiffs; and on Tuesday, in the Chancery Division, a motion came on for hearing before Mr. Justice Stirling asking for an interim injunction pending the trial of the action. On being reached, counsel for the plaintiffs intimated that the defendants had agreed to an order being made to treat this motion as the trial of the action, to consent to perpetual injunction, to pay the costs, and the damages to be assessed after inquiry. Counsel for the defendants assenting, his Lordship made an order in the terms arranged.

The "Geryk" Patent Vacuum Pump.—We illustrate below a pump which has been especially designed for the production of high vacua in laboratories, and is adapted for research work, which it is stated to have already greatly assisted on several occasions. As a sample of the speed attained, it is stated that in a recent public lecture the pump was used to show the process of exhausting an



incandescent lamp, commencing with the lamp full of air and proceeding to final exhaustion. The operation lasted only a few minutes. The pump shown in the illustration (duplex A) is fitted with rotary motion to be driven by hand or power, and is built for continuous running in factories as well as laboratories. A large number of the pumps are said to be in use in incandescent lamp factories for exhausting lamps direct, and in connection with chemical methods.

Patent Case.—The *Halifax Guardian* says that the case of Best *v.* Peel was heard of on the 11th ultimo, before Sir H. Reader Lack, Comptroller of Patents. The applicant, John Peel, electrical engineer, Morley, applied for a patent for an invention relating to electrically lighting miners' safety lamps, the grant of his patent being opposed by William Best, and secondly, that the invention had been previously patented by the said William Best. Messrs. Brewer and Son, of Leeds, acted as patent agents for the opponent (William Best), and Mr. John E. Walsh, of Waterhouse Chambers, Crossley Street, Halifax, acted as patent agent for the applicant (John Peel). The Comptroller has now given his decision that the opposition fails, he being of opinion that Peel's invention had not been previously patented by the opponent, and that the allegation of fraud was not established. He will proceed to seal a patent to John Peel in due course.

Personal.—Mr. W. S. Graff Baker informs us that he has severed his connection with the General Traction Company, Limited, of 35, Parliament Street, Westminster, and removed his offices to 13, Austin Friars, London, E.C.

St. James's and Pall Mall Electric Light Company, Limited.—The sale of electricity for the three months ending March 25th, representing the supply at 6d. per unit, amounted to £16,862, as against £13,907 at the same rate for the corresponding quarter of 1895.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The report prepared by Mr. Smith, the gas superintendent, and Mr. Blackman, the electrical engineeer, *re* extensions in the electricity supply, states that the generating plant at the works at present is capable of supplying 8,400 8-C.P. lamps, and with the addition of the 300 H.P. engine now under contract, they will be able to supply 11,600 lamps. There are 17,500 8-C.P. lamps now connected up, and it is expected that about 60 per cent. of these will be alight at the same time next winter. Applications received from Golden Square and George Street will necessitate the extension of mains there, and this the report recommends the Council to approve. With the view of supplying lighting and motive power in the harbour district, it is advised that another engine and dynamo should be obtained in addition to the one now contracted for, with additional boiler power, that the buildings should be extended, and another chimney shaft built. This new plant would be capable of supplying 4,900 lamps, with adequate reserve both as regards engines and boilers, while the buildings would be capable of meeting the requirements for some considerable time. The estimated cost of the new buildings, engine, dynamo, boiler power, &c., is £9,500. With reference to the west end, it is stated that in the opinion of the reporters the time has now arrived when an extension to that quarter might be considered. As the result of a circular letter sent to 240 householders in the district, 80 replies were received, and of these 32 were favourable. The additional plant recommended would be sufficient to supply the west end for a commencement. The mains to the west end would cost £9,500, and would also supply the harbour. If the mains were laid down, 16,000 units might be expected to be sold within the next 12 months, for which a revenue of £350 would be received. In addition to that there would be the revenue derived from the harbour district, the amount of which there is at present no means of estimating. The memorandum as to cost gives:—Buildings, £4,590; engines, £5,000; mains, £9,500—£19,000. A statement as to the estimated revenue and expenditure shows that, after allowing for interest, sinking fund, and depreciation, there would be an apparent surplus of £89 on the existing district, and an apparent deficiency of £441 10s. on the western extension, the net apparent deficiency thus being £352 10s.

Bangor.—Lord Penryhn has enquired upon what terms the Council will supply current to Penrhyn Castle. The Council has resolved, conditionally, to lay a main to the Castle.

A meeting of local architects has decided to support the electric lighting scheme.

Blackpool.—The Town Council, on 7th inst., adopted the minutes of the Electric Lighting Committee, which provided for the acceptance of the tenders, mentioned in Electrical Review for March 6th, for work connected with the extensions in the electrical supply. It seems that the Winter Gardens Company and the committee being unable to come to terms, the company is to put down a private plant.

A correspondent informs us that there is a feeling among the Town Councillors that the vacancy caused by the electrical engineer, Mr. Hesketh's, resignation, should be filled by the assistant gas manager, Mr. W. Chew, who, we believe, was recently elected an M.I.E.E.

Bolton.—There were 45 candidates for the position as electrical engineer to the Bolton Corporation, and out of these five have been selected to appear before the Committee.

In regard to the recent application on the part of the tradesmen for a reduction in the charge made for the electric light, information is being obtained from other towns as to the operation of the Brighton system. In order to furnish a practical example of the effect of such scale, the engineer is authorised to arrange for a demand indicator being placed in one of each of the following description of premises:—A private dwelling house, a shop, and a mill or works. During March, the amount of cash received on account of the electricity department was £1,541, as against £461 in the same month last year.

Belfast.—The engineer has reported on the progress and development of the electric light. He has been instructed to examine and report upon sites available for a main central station, capable of extension and accommodation for all the wants of the city for many years hence.

Bradford.—The Council has accepted tenders for supplying and fixing machinery and plant at the new Electricity Works, Valley Road, amounting to £7,543 10s., and tenders for the erecting of the buildings required, amounting to £11,448 6s.

Brighton.—The electrical engineer has reported with reference to raising additional capital for the purposes of the electricity undertaking. He shows that the number of consumers has grown to 1,121, against 872 in 1895, that much of the increase arises from the supply to private houses, and that the new applications received this year indicate that the rate of increase will be maintained. The £27,500 now needed will be expended as follows: Street lighting mains already laid, £4,470; extensions at generating station, £5,750; machinery and plant, £1,500; mains, house services, and street lighting mains, £10,000; contingencies, £1,280; street lighting already executed, £2,300; further works, £2,200. As stated last week, the amount has been voted by the Council, and application is to be made to the Local Government Board for sanction to borrow it.

Church Lighting.—Duncansburgh Church, Inverness-shire, is to be lighted electrically.

Derby.—A Local Government Board inquiry was held on 8th inst. respecting applications of the Town Council for sanction to borrow £13,185 for purposes of electric lighting.

Dudley.—A sub-committee is going into the question of the town gas supply, and in its deliberations electric lighting is to be fully considered.

Dock Lighting.—A contemporary says that the Graving Dock Committee of Tees Conservancy Commissioners are to consider alternative tenders for lighting the dock by gas and electricity.

Ealing, W.—The Council has decided to extend the electric lighting mains to Gunnersbury, if Mr. L. de Rothschild and the other residents will pay the "interest on the capital charges, a certain sum annually for depreciation, and a minimum of £50 a year for the supply."

Grimston.—Saxilby Hall, Grimston, near Melton, is now lighted throughout with electricity, the current also being laid on to the stables and other out-offices. Mr. W. J. Furse, of Nottingham, was entrusted with the whole of the electrical arrangements.

Hampstead.—An electric lighting main is to be laid from Alexandra Road to High Road, Kilburn, for private consumers, at a cost of £462.

Harrogate.—The Local Government Board has sanctioned the whole of the loans for the electric lighting scheme, amounting to about £25,000, and the Town Clerk is pressing forward the various contracts for machinery, plant, &c.

Hospital Lighting.—"In view of the superior healthiness, cleanliness, and convenience of the electric light, coupled with the fact that part of the gas system is much out of repair," the Board suggested to the Governors of the Norfolk and Norwich Hospital that the hospital be lighted electrically, the initial outlay being £800, the annual cost of maintenance being estimated at less than that of gas lighting. The supply will be taken from the Norwich Electricity Company's mains. Five hundred lamps will have to be fitted, and Messrs. Laurence Scott & Co. estimate the cost at about 28s. per lamp.

Islington.—We learn that the Electric Lighting Committee of the Islington Vestry have decided to at once increase their plant, with a view of extending their system of public lighting from the Nag's Head, Holloway Road, to the Archway Tavern at Highgate Hill, and also for the purpose of supplying the light to the Northern Polytechnic in the Holloway Road, and the Royal Agricultural Hall.

Lambeth.—The electric lighting question has given rise to a lot of ill-feeling at Lambeth, and consequently there have been some very lively meetings held there lately. There is talk of "alleged scandal," "votes of censure," and the folly of the Electric Lighting Committee in recommending the Vestry to part with its electric lighting powers to a company (see last week's Electrical Review). The so-called "progressists" seem to be exercising an obstructive policy regarding the Committee's recommendation. To us, however, there seems little probability of the Vestry carrying out the work themselves, and, therefore, the truly progressive party is that which supports the proposal to transfer the order; otherwise the matter may hang up for several years longer, unless the Board of Trade sees fit to interpose. However, we cannot but think that the more level-headed vestrymen will quash the obstruction of the dog-in-the-manger party. Another special meeting was to be held last night.

Llandudno.—The District Council has adopted the report of Mr. A. H. Preece, to which we referred last week, relative to the lighting of the town by electricity, and decided to borrow £25,000 to carry out the scheme.

Llanidloes.—At its next meeting the Council will consider the advisability of lighting the town with the electricity.

Llandrindod Wells.—The District Council last week considered details of the proposed electric lighting scheme with Mr. Edward Davies. It is hoped to have the work proceeded with immediately.

Leamington.—The Council has before it a communication from the Midland Electric Light Company on the subject of the introduction of arc lights for the purpose of street lighting. The surveyor is to obtain results from various towns where arc lighting is in use.

Lincoln.—Upon the Electric Lighting Committee's recommendation, the City Council has resolved to take the necessary steps to secure a provisional order.

Liverpool.—The Lighting Committee, on 10th inst., discussed at considerable length a report as to the lighting of the city on a systematic general plan, involving the use of both gas and electricity.

The Transfer Bill of the Liverpool Electric Supply Company passed the Committee of Ways and Means, with amendments, on Tuesday.

Monmouth.—The Local Government Board having consented to the drainage, electric lighting, and sewage disposal scheme to cost £20,000, of which sum £8,115 is for electric lighting, Messrs. Bramwell & Harris and Mr. Lailey have been authorised to invite tenders for the various works.

Motherwell.—The Lighting Committee recommends the Police Commissioners to proceed with the electric lighting of a number of stated streets at a cost of £8,500. The Commissioners have, for the present, rejected the recommendations, for by seven votes to four they have adopted a policy of delay.

New Malden.—The Town Clerk of Kingston has communicated to the New Malden District Council again, inquiring whether, in view of the expressed desire on the part of residents at Coombe to participate in electric lighting, they would consent to the supply of electricity to that district from the Corporations works at Kingston. The clerk stated that, acting under instructions, he replied to the Town Clerk's previous inquiry to the effect that the introduction of electric lighting mains at Coombe would be premature at present. The chairman pointed out that to grant this power sought by the Council would, under ordinary conditions, give the Corporation a monopoly for 42 years, but they might possibly be able to arrange for a less period. Mr. Monro moved a resolution to the effect that the Council would be prepared to favourably consider the application of the Corporation if satisfactory terms could be arranged. The motion was carried *nem con.* It was also resolved that the Lighting Committee consider as to terms and report.

St. Helier.—An opening occurs at St. Helier (says *Daily Tenders and Contracts*) for the establishment of a lighting station to supply either gas or electric light. Particulars may be obtained of P. Baudains, Town Hall, St. Helier, Jersey.

Whitehaven.—The Harbour Commission has resolved, on the recommendation of the Electric Lighting Committee, to "rest on the existing agreement for the lighting of the harbour by electricity."

Portsmouth.—The military authorities have sanctioned the erection of one arc lamp and two incandescent lamps on the old saluting battery at the entrance to Portsmouth harbour. The Electric Lighting Committee have instructed the superintendent to prepare an estimate of the cost of the incandescent lighting in side streets.

Tenders have been invited for carrying out the work of wiring the Public Lavatory for the electric light to be installed there.

Southsea.—Electric lighting at Southsea is to be proceeded with, and low tension mains are to be laid from Elm Grove, through Yarborough Road and the Retreat, to Grove Road South.

Swansea.—At a meeting of the Electrical Committee of the Corporation, on Monday, the offer of Mr. J. C. Howell to take over the Corporation powers for electric lighting was considered, but it was resolved not to part with the powers, at any rate at present.

Taunton.—Application is to be made to the Local Government Board for raising a £3,000 loan for electric lighting extensions.

Walsall.—The Council has agreed to light the Bridge, Park Street, Bradford Street and Lower Bridge Street with electricity, and the necessary lamps, &c., are to be provided at an estimated cost of £621 10s.

Wells.—The Gas and Electric Lighting Committee recommend the Council to send a copy of the Local Government Board's letter *re* the purchase of the gasworks to the gas company. The electric lighting question will be considered at the next meeting.

West Ham.—It is proposed to appoint a committee of 12 members to superintend matters connected with the electric light installation, and report periodically.

Yarmouth.—The Surveyor reports that since the last Council meeting, applications have been received from 10 customers for 606 lamps, the total number of customers now being 160 for 7,603 lamps. The income for March was £180 16s. 8d., and the working expenses £142 8s. 11d., showing a balance of £38 7s. 9d. to meet outgoings of £100 per month for capital, repayments, interest, charges, &c.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Altering the Portrush Electric Railway System.—At the last meeting of the Town Commissioners, the Clerk read a letter from Mr. W. A. Traill, C.E., engineer of the Giant's Causeway and Portrush Electric Railway, intimating that he purposed attending the Board's meeting to answer any inquiries in reference to their proposed alteration of their electric system for working their tramway to the overhead system. They intended to erect iron or steel posts on the insides of the pathway, with projecting brackets to carry the conducting wire. At the curve at the Methodist Chapel they would erect an ornamental post in the centre of the triangle between the roads, and place a lamp for gas thereon, allowing a clear headway where crossing the road of 18 feet. Mr. Traill attended the meeting, and explained the details of the scheme. He explained that the posts would be erected, for the most part, on the inside of the footpaths, with projecting arms over to the centre of the tram line. The posts would be of drawn steel tube, 4 inches in diameter at the base and 3 inches at the top, and the projecting arms would be 1½ or 2 inches in diameter. In reply to Mr. Scott and others, Mr. Traill said the projections would be of best steel, and every precaution would be taken against the possibility of accidents. Suggestions were offered by various members of the board, after which Mr. Macaulay proposed that the Commissioners approve of the alterations, subject to Mr. Traill's assurance that nothing unsightly would be placed in the streets. This was agreed to after further conversation.

Brighton and Rottingdean Electric Tramroad.—The Unopposed Bill Committee of the House of Commons on Wednesday passed the Bill granting an extension of time until July, 1898, for the completion of the authorised Brighton and Rottingdean Seashore Electric Tramroad. The Bill also empowers the company to raise £10,000 additional share and loan capital.

City and South London Railway Extensions Bill.—This Bill was on Monday advanced a stage by Mr. Thoms, one of the House of Commons Examiners of Private Bills. It will be remembered that the object of the Bill is to secure an extension of time for completing the new lines.

Dublin-Dundrum Tramways.—On 10th inst., at Dundrum, a Board of Works inquiry was held with reference to the proposal of the Rathmines, Dundrum and Blackrock Tramways Company, to run a system of electric tramways on the overhead wire system.

Edinburgh Cable Tramway Contract.—We hear that a committee of the Council recommends the acceptance of the tender of Messrs. Dick, Kerr & Co., Limited, for the construction of a road track in connection with the cabling of the tramway system, the amount being about £180,000.

Electric Tramways for Ayr.—At the meeting of the Town Council on Monday—Provost Willock presiding—a report by a committee was submitted, recommending that the Corporation should construct a line of tramways from Burns' Monument to Prestwick through Ayr, a distance of six miles, and that the motive power should be electricity, generated at the electric lighting works. The report was unanimously adopted, and the matter referred to the Bills Committee.

Leeds Tramways.—Dr. Hopkinson attended a meeting of the Tramways Sub-Committee on Tuesday, and discussed several matters with a view to the preparation of specifications of the cost of the equipment of the electric tramway system, which it is proposed to establish between Roundhay Park and Kirkstall.

Proposed Electric Tramway.—The Scarborough Town Council has declined the application to entertain the question of an electric tramway from the South Foreshore Road to Peasholm, along the proposed marine drive.

Portsmouth Tramways.—Negotiations have been commenced by a committee of the Town Council as to purchasing the Portsmouth tramways, leasing the same to the company, and supplying them with electrical energy for their cars.

TELEGRAPH AND TELEPHONE NOTES.

Cable Making in Germany.—A new firm has just been formed in Berlin, N., to be known as Messrs. Dr. Cassirer & Co., to manufacture cables.

Exports of Telegraph Wire and Apparatus.—The returns which are now available regarding the exports from this country during last month of telegraphic wire, and apparatus connected therewith, shows that this branch of trade was very quiet during March, as compared with the preceding month, the value having only amounted to £21,238, as against £109,840 in the preceding month. In March, last year, the exports were valued at £19,598, while in March, 1894, these amounted to no less than £112,423. It is satisfactory to find that, taking the first quarter of the year, the returns show a more favourable total than in either of the two preceding years. For the quarter ending March last, the exports are valued at £167,064, as compared with only £44,604 in the corresponding period of last year, and £151,856 in the first three months of 1894.

(*Continued on page 509.*)

GEAR FOR JAPANESE SUBMARINE CABLE STEAMER.

A few months ago the Japanese Government, as represented by their Glasgow Consul (Mr. A. R. Brown), entrusted Messrs. Johnson & Phillips with the construction of a combined picking up and paying out gear, together with outfit and stores, for their new submarine cable laying vessel, of which the following is a description:—

The gear, as shown in the photographs which we reproduce, is very compact, and has been constructed principally of steel, so as to combine strength with lightness, the weight, all told, being only about 21 tons.

Although specified to pick up under a strain of 25 tons at 175 lbs. pressure, the gear, on official trial, showed itself equal to a much greater power. Compared with the gear by the same makers, fitted on the *John Pender*, *Great Northern*, *Chiltern*, *Electra*, *Magneta*, *Recorder*, *Relay*, *Cita de Milano*, and many other steamers, it is equally powerful as the three first named, and twice as powerful as the others, while at the same time it is infinitely more compact and lighter than any that have gone before.

Submarine Cable Gear.

The gear stands on a strong steel girder bed on the main deck, and the drums, &c., project through a hatch in the spar deck, and this is fitted with covers, which form the driving platform for the machine. The gear has overhung drums, 6 feet 3 inches diameter × 2 feet 6 inches wide, internally geared, and running loose on a fixed shaft carried on two steel frames, and is arranged for four speeds. The motive power consists of one vertical compound engine, having cylinders 12 inches and 24 inches diameter, by 14-inch stroke, capable of developing 265 H.P., without the use of the condenser, in conjunction with which it will, however, generally be used. The engine is fitted with link motion reversing gear, and also with automatic bye-pass valve, for admitting high pressure steam to low pressure cylinder for starting. The crankshaft is geared to the first motion shaft of the machine by means of double helical bevil gear. When it is desired to pay out without steam power, the only moving portion of the machine is the drum, which is readily controlled by the brake. To enable the drum to revolve independently of any other part of the gearing, provision had to be made for sliding the drum pinions out of gear, and as it was essential to keep the drums close up to the frames, these pinions have been arranged to draw through the frames. This has been effected in a very neat manner by the makers, two large holes being cut in the frame plates, and a large pocket casting fitting into these, carrying bearings each side of the frames, so that the pinions which gear into drums run between two bearings, the arms of the drum being set back to allow for this outer bearing, and this arrangement ensures a very substantial job. These pinions are put into and out of gear by means of a combination of hand wheels, screws and bellcrank levers. All wheels are arranged to draw out of gear when necessary, so that only the particular set required needs to be in gear.

The brake straps are of steel plate, fitted with elm blocks. The lower parts of the straps have large cast-iron eyes attached to them, and these are kept in position by means of a shaft 3½ inches diameter, which passes through both frames.

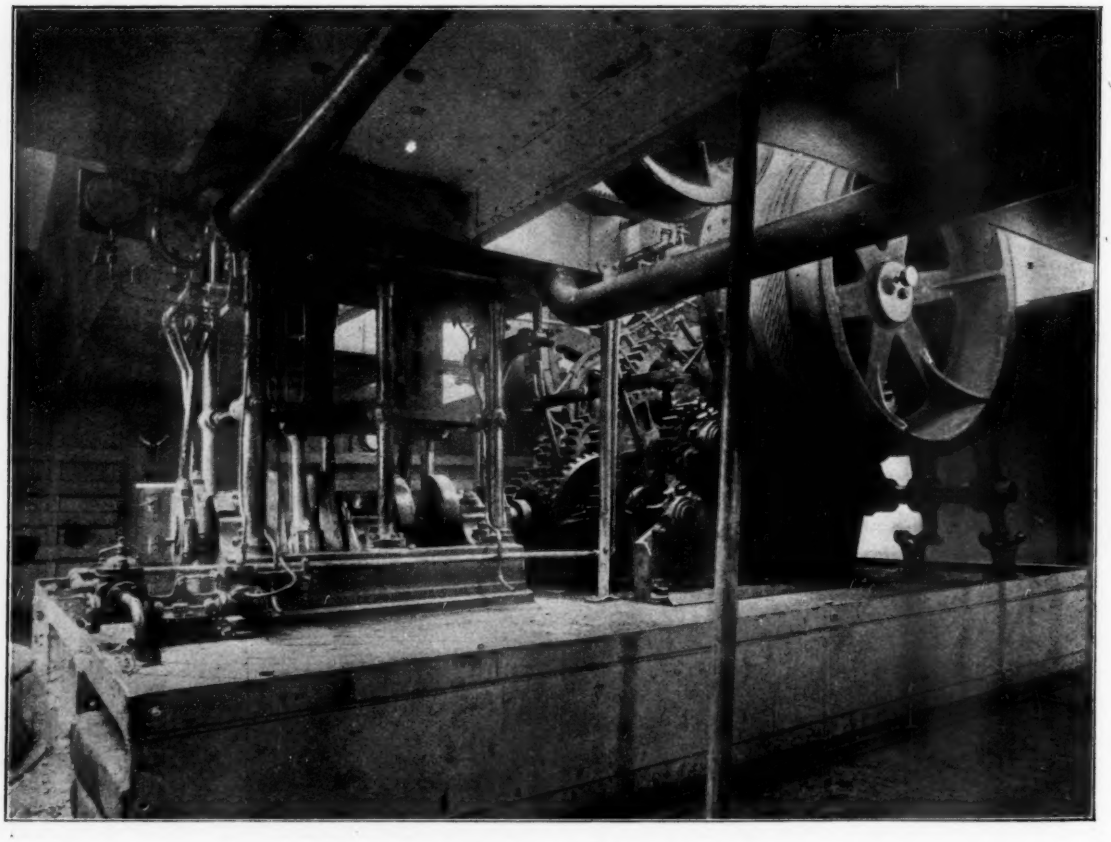
The braking power is applied by means of right and left-hand screws working in nuts attached to the upper parts of the straps, the screws being actuated by means of hand wheels from the starting platform, and when the straps grip the brake drum the pull is transmitted to the machine frames (through the before-mentioned eyes and shaft), and thus to the deck of the vessel. A water service is provided for the brakes, the water being distributed by means of a small Worthington pump.

Each drum is provided with two "knives" for fleeting

the cable on the drums to suit either an inside or outside lead, as the case may be.

Bow Gear.—There are three sheaves at the bows 51 inches diameter by 11 inches wide, the two outer ones being V-section and the middle one U-section. These sheaves are of steel, with gun-metal bushes, and they are arranged to run loose on a steel shaft fixed in blocks carried on four steel girders, which are built into the ship for a distance of several feet, being connected to the beams and to the steel deck, thus ensuring a very substantial job. Each sheave is provided with a cast-iron "whisker" or guard at each side to prevent the cable from coming off. The two outer whiskers carry davits with a cross-bar for convenience in launching mushrooms, grapnels, &c. The side plating of the ship is carried out to meet these castings, thus giving the bows a very neat appearance.

Stern Gear.—This has but one sheave, which is 38½ inches diameter by 11½ inches wide, and is fitted with gun-metal liner to run loose on a shaft fixed on blocks carried by rolled girders. These girders are attached to the deck by means of special castings, which also serve to secure the necessary stopper hooks.



Submarine Cable Gear.

The cable machine is placed just aft of the foremast, and between it and the bow sheaves are placed the two dynamometers (one for each drum) for the purpose of registering the strains that come upon the cables or grapnel ropes. To effect this, a set of leads consisting of A-frames and sheaves is placed at a certain distance on each side of the dynamometer, so that when a strain comes upon a cable or rope the moving part of the dynamometer is raised, the distance raised being the measure of the strain according to the weight of the moving part.

Dynamometers.—The dynamometers are of Messrs. Johnson and Phillips's improved design, consisting of cast-iron footstep with steel cylinders, on which a large cast-iron sleeve slides, and to this sleeve the sheave is attached, and also two side rods, which carry a cross-head some distance above. To the cross-head is attached a piston rod with piston, which works on the outside of the steel cylinder, which is filled with oil, and the piston being a loose fit, this acts as a dash pot to steady the movement. The top of the steel cylinder is, of course, fitted with a packed gland.

THE RÖNTGEN RAYS.

In a paper read before the Elektrotechnischer Verein on February 25th, by G. Klingenberg,* an excellent account is given of the historical and theoretical bearings of the investigations which have led up to Röntgen's discovery, and also a description of the experiments on the X rays, which have been carried out in the Electrotechnical Laboratory of the High School at Charlottenburg.

It has been asserted, on the authority of Prof. J. J. Thomson, that the cathode discharge inside the tube produces no impression on the photographic plate. As this experiment has a very important bearing in establishing the true relation between the cathode and the X rays, it is important that there should be no doubt as to the result. In this connection, some experiments made by Brereton Baker† are of importance. These experiments appeared to show that the presence of oxygen is necessary for the blackening of chloride of silver under the action of light. When operating in vacuum, no blackening of the silver salt was observed. That under some circumstance the cathode radiation inside the tube does make an impression on a photographic film was long ago shown by Goldstein. He introduced,

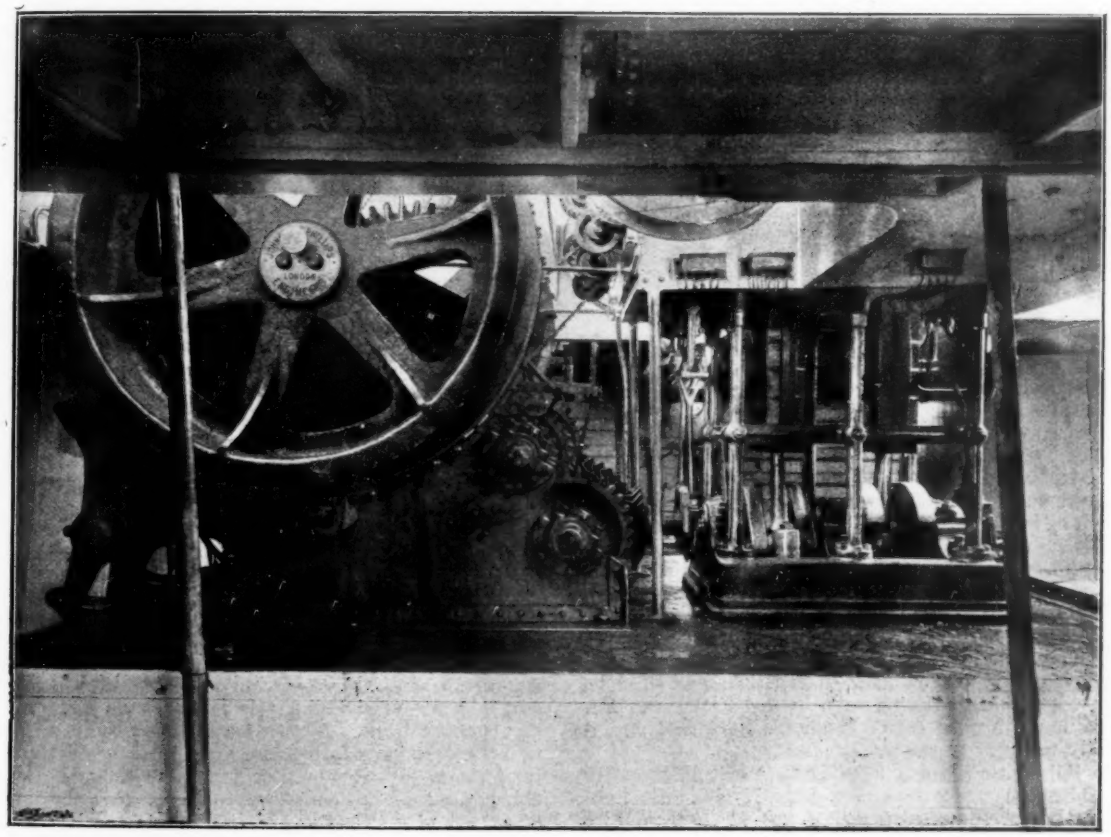
* *Elektrotechnische Zeitschrift*, xvii., p. 220, April 2nd, 1896.
† *Journal* of the Chem. Soc., 1892, p. 120.

with infinite difficulty, small photographic dry plates into the tube, and likewise photographic printing paper, and established the fact that the photographic emulsion was blackened by the action of the rays. He showed, also, that there were different kinds of cathode rays, among which were some that were not deflected by a magnet.

Lenard, of course, investigated the photographic effect of the cathode rays outside the tube, as Goldstein had done inside the tube, and was able to prove the existence of a strong photographic action. A dry plate was blackened in a few moments, and photographic printing paper placed near the window of the Lenard tube was darkened at about the same rate as by daylight in cloudy weather. Lenard also used the photographic plate to investigate the transparency of different substances. Unfortunately for himself, the thought did not occur to him to make exposures of objects inclosed in boxes, or of parts of the human body, for which he had in his hands all the apparatus necessary, and thus he narrowly escaped making the world-wide sensation which has now been produced by Röntgen's discovery.

The first successful experiment in the Charlottenburg laboratory was made with a Lenard tube, since the Crookes tubes in their possession were found to give no results. This shows that the rays which Lenard was investigating were capable of producing the Röntgen photographs, if they had only been applied to this purpose. A great many forms of tube were tried, and important points in their construction were found to be as follows:—In the first place the distance apart of the terminals should not be too great—it should be at least three-fourths of the spark length of the induction coil used, since otherwise, with high vacua, the spark may pass outside between the terminals. Then the tube should be so designed that the spark does not pass from the corners of the electrodes through the glass to an opposite terminal; since the vacuum is the best insulator, the edges of the electrodes and the terminals should not be close to the walls of the tube. To protect the cathode rays from the attractive influence of the anode, the latter can be made in the form of a ring, through the centre of which the cathode rays are directed. Tubes with this arrangement were made by Goldstein.

The effectiveness of the tube can be increased by increasing the number of discharges from the coil. For this purpose a rotating interrupter was used, consisting of a toothed wheel driven by an electromotor at any required speed, and against the edge of which a spring was pressed. The interruptions were made under running water to reduce the disturbing effects of the sparking. The self-induction of the coil, of course, increases with the frequency of the interruptions, and, as a consequence, the tension decreases; there is, therefore, a most effective frequency which is easily found by experiment. This kind of interrupter has also the advantage that it works with great regularity, and makes comparative measurements easy.



Submarine Cable Gear.

Still stronger effects are produced with alternating currents, but the heat developed in the tube is so great that it is soon destroyed. Very good results can also be obtained with Tesla currents, and with these the heating effect is much less. * Himstedt's modification of Tesla's apparatus was used, in which an air condenser is in the secondary circuit of the Tesla transformer in parallel with the tube.

A peculiar phenomenon, by which the action of the tube is very much influenced, is the dissipation of the electrodes. It appears that the electrodes are disintegrated by the rays; of course, the vacuum is deteriorated by powerful discharges, and attains its original degree only after a long rest. After repeated use, the tubes get covered with a black metallic mirror. Tubes of large volume last longer, and are for this reason to be recommended. Very good results have also been obtained with small coils having a spark length of 4 to 5 cm.

* *Wied. Ann.*, 1894.

Herr Tschiersch,* of Dortmund, has succeeded in greatly reducing the time of exposure, when the influence machine is applied to excite the X ray tube, by introducing a spark gap in the tube circuit. In previous experiments with the influence machine, exposures of three-quarters of an hour to an hour were found to be necessary, but Herr Tschiersch has obtained good photographs with exposures of four to five minutes, and even in his most recent experiments of one minute. The machine used was a Holtz machine, giving a spark of 11 inches in dry air. The best length of spark gap to be employed in each case must be determined by examining the radiation given out from the tube by the phosphorescent screen. The spark gap is best placed close to the cathode. If it is placed near the anode, cathode rays may be developed on part of the tube surface by merely touching it with the finger or any conductor connected to the earth.

The phosphorescent screen, which is almost as important as the tube, in the practical application of the X radiation, has recently been the subject of several improvements, which may or may not be all that their discoverers claim for them. Prof. Richarz, of Greifswald,† having observed that when a phial filled with barium-platino-cyanide was exposed to the X rays, its contents became brilliantly phosphorescent to the centre of the mass, came to the conclusion that a considerable mass of the substance must be used on the screen. He therefore constructed his screen by introducing a thick layer of the salt between two glass plates. The glass plates were 20 cm. by 10 cm., and the weight of the substance used was 20 grammes. This surface density of 10 grammes per cm., is almost exactly the same as Mr. Jackson uses on his screen.

Dr. Macintyre,‡ of Glasgow, has also been making some experiments with phosphorescent screens. He finds that the tungstate of calcium recommended by Edison gives good images when the crystalline form is used, but that potassium platino-cyanide is the best substance to use. Mr. A. Hutchinson, of Cambridge,§ finds that scheelite, the native tungstate of calcium, gives an image as bright as the barium platino-cyanide, and that the phosphorescence continues for some time after the X rays have ceased to act. This latter peculiarity would militate against its applicability as a phosphorescent screen. Mr. Edison's experiments with phosphorescent substances are described by himself in the *Electrical Engineer*, N.Y. He obtains his crystallised tungstate of calcium by the fusion process. Differing from all other experimenters who have tested this substance, he makes the extraordinary assertion that "the tungstate salt is six times more sensitive to the ray than platino-barium cyanide. Plates of hard calendered pasteboard, covered with crystals, permit, with a good tube, the seeing of all the bones of the hand and arm." Mr. Jackson, with his potassium platino-cyanide screen, is able to do much better than this, since he shows quite distinctly the human ribs and backbone. Mr. Edison, in making his comparison, must have used an insufficient thickness of the platinum salt.

Mr. Edison has tested a large number of substances for phosphorescence under the action of the X rays. He finds that the best phosphorescents are not necessarily those with the highest molecular weights. Some organic substances, such as salicylate of ammonia in crystals, give excellent results. The following observations made by Mr. Edison are of interest, from a theoretical point of view:—

A curious phenomenon occurs in tubes which are best adapted for the X ray. After obtaining a high vacuum on the pump, where the line spectrum disappears, and pure fluorescence and the X ray is strongest, the lamp is sealed off. In a short time, varying with the different lamps from one to three hours, the vacuum becomes poor. All the phenomena of low vacuum take place in light, and the vacuum is really low, as ascertained by experiments while on the pump. If now the tube be kept in connection with the current, it will gradually go through all the changes to a high vacuum, the line spectrum will disappear suddenly, and X rays will appear. If the bulb be left for 24 hours, it requires 4½ hours' continuous connection with the current to bring it back to the X ray stage. Eighty per cent. of the lamps act in this manner; it is independent of the kind of glass, and of many variations made in the pump; it occurs with, or without, phosphoric anhydride. It would seem that the effect was due to atomic electrolysis, free atoms being disconnected with the ether, only molecules being connected so as to produce pressure on the walls of the tube.

* *Elek. Zeitsch*, xvii., p. 217.
† *Elek. Zeitsch.*, xvii., p. 226.
‡ *Nature*, April 2nd, 1896, p. 523.
§ *Ib.*, p. 524.

An interesting application of the new photography, as given in the *Western Electrician*, Chicago, shows of how much importance Röntgen's discovery may prove to the surgeon:—

On February 24th Dr. Burry and C. E. Scribner took a sciagraph of a woman's thigh, the ray passing through to the hollow in the thigh bone containing the marrow. It showed that a portion of the bone midway between the knee and the hip joint, 2 inches long and an inch wide, was entirely gone, and its place was filled up by a spongy growth. The diseased condition was so apparent in the picture that Mr. Scribner, without medical education, accurately described its existence and form. The operation showed that sarcoma had attacked the thigh bone in its interior, and had produced, in size and shape, a condition exactly corroborated by the picture.

The importance of the operation lies in the fact that it demonstrates that the X ray furnishes a new means of diagnosing not only sarcoma, but other diseases of the bones, the presence of which, with the means hitherto available to medical science, have often been so obscured, that the knowledge of the existence of a malignant disease has been so deferred as to make it impossible to avert fatal results. This is the first known instance of the use of the ray in such deep-seated structures.

THE RELATIVE VALUE OF DIFFERENT COALS.

Writing in the *Engineering Magazine*, Mr. Chance declares that the commercial value of coal is simply as the thermal capacity. This is in a sense quite true, but there are limitations in practice which have hitherto kept the value of coal at a point determined by other conditions than its calorific power. If in a week's work, two coals of equal total cost delivered, produce different amounts of ash and clinker, then the better coal would be that producing the amount of refuse most acceptable, and it is easy to imagine conditions where the greater amount of refuse would be acceptable, though usually the smaller amount would be preferred.

But there is another side to the question. The rapidity with which coal can be burned is a very important factor in many works, and a coal may be of full value as an evaporator, and yet be incapable of burning at the rate required, because it is too fine and must be burned at small rates per square foot. In the North of England coal of small size, known as slack, does not fetch a price so far inferior to the larger stuff as is the case in the London district, where slack coal sells for very considerably less than its real quality should obtain for it. A cause for this may be the competition of smokeless coal. Smokeless coal is the great refuge of the fireman. It enables a poor fireman to show as clean a chimney as the best fireman, and to this extent is always sure of a good word all round, and excuses and complaints will be made where bituminous coal is used, that would not be entertained or attempted where smokeless coal is not to be had, and where the ordinary rate of coal consumption is much greater per square foot of grate than in districts using smokeless coal.

As Mr. Chance says, there is always much trouble where a change of fuel is attempted, even when the change is to a better quality, and it requires persistence until the firemen become accustomed to the change. These complaints are natural enough, but where there are no real grounds for complaint they die gradually away.

Taking things as we find them, the best coal to use in any particular case is the cheapest that can be made to do the work. This is a general, if dogmatic statement, and directly opposite to the customary dictum that it does not pay to use cheaper fuels. The facts are, that it does pay in most instances, and that where there is space available, it would often pay to put down more boilers in order to have grate area to burn smaller and cheaper stuff. We know where the use of exceedingly dirty fuel and fan draught effects great economy, though it necessitates the special employment of boys to clean the bars, which become very badly clinkered through the operation of the forced draught on the dirty

fuel. It does pay to use the cheaper fuels, simply because the cheapness is the result of a certain attendant inconvenience on small and dirty fuel, and if this can be borne, the fuel can be used to advantage. Obviously, as pointed out, some of the best of coals, when used at one place prove bad at others. A fuel throwing much dust may cause the tubes to clog in a way they would not do if the tubes were vertical, or if the draught were different, or less fire stirring could be done, and every boiler becomes a law to itself as to what is the best fuel to use, and it is extremely doubtful if mere calorific value has any serious effect on the final choice. The relative amount of the hydro-carbons has great effect on the value of a coal, a large amount of volatile matter being nominally more valuable than an equal weight of carbon; but there is less difficulty in consuming the less valuable coal, because the smoke question comes in, and the current unscientific arrangements of furnaces renders it difficult to deal satisfactorily with bituminous coals, so much so, that many engineers, including some who might be expected to know better, state that the hydro-carbons *cannot* be utilised, and they do not hesitate to repeat this in face of carefully conducted tests, showing to the contrary, being on record.

Average good American coals are stated to contain 1 per cent. of water, 5, 18 and 40 per cent. of volatile matter for anthracite, semi-bituminous and bituminous coal, and similarly, 88½, 75½, and 40 per cent. fixed carbon, the remaining 5½ per cent. being ash and sulphur. In low grade fuels, the figures become 2, 3, and 4 per cent. of water, 5, 15, and 34 per cent. volatile matter, and 75, 67, and 46½ of fixed carbon, the remainders being now 16, 12, and 12 per cent. of ash, &c., the sulphur especially being from four to six times greater. Analysis of coal is useful to the steam user to a certain extent, in that it enables him to see if his conditions are suitable to the obtaining of a fair duty, or if, the duty being small, the coal can be rightly blamed or not. The presence of water is especially pernicious if it has to be paid for. Some water in a furnace is, perhaps, valuable, as having a possibly good, but obscure, effect as a carrier; but let the steam user add this for himself. The large percentages of water in lignites account for their low duty, no doubt. While we do not place much reliance on the suggested registration of firemen, believing that many of the best and most intelligent of them would be plucked in the most trivial examination, we do think something might be done to pay them better, and make of firing more of what it should be—a skilful operation in destructive chemistry.

To be able to read, or write, or do a few elementary sums, is well enough in its way. We look for that sort of thing from Bishops who have absolutely no past experience in firing, but they do not necessarily constitute a safeguard that their possessor can attend to a boiler, with the various details of duty involved in firing economically, and maintaining water levels right and safety valves in order.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 504.)

Telegraph and Telephone Matters in Parliament.—In the Commons, on 9th inst., in the course of the discussion on the vote of £6,442,120 for Post Office salaries and expenses, Mr. Provand suggested that the telephonic service should be improved in districts which had not been taken over. It was a scandal that the Post Office should continue to nurse the monopoly of the National Telephone Company, and he thought the offer of a limited competition of the Post Office, which the right hon. gentlemen had promised in cases where the supply was proved to be unsatisfactory, was inadequate. He complained that members had not had sufficient notice that the vote would be taken that day. All the objections that might be raised would disappear on examination, and the Municipality of Glasgow, if it had the power, would be able to replace the present unsatisfactory and costly service with a telephone exchange that would meet the requirements of everyone at the subscription rate of £5 a year. The many advantages the municipality possessed would enable them to do this. They had full control of the streets, they had many public buildings which would be used for the overhead service, they would obtain way-leaves cheaper than any company, and in the event of the municipality requiring capital they could raise it at 2½ per cent. Glasgow was willing to accept the license under any conditions the Post Office authorities might think necessary, always provided they had freedom to supply the best service in their power. He would also like to know what the Post Office authorities intended to do in regard to the new international telegraphic code, which was to come into operation, so far as Europe was concerned, at the end of 1897. He was opposed to that code. He thought this country should continue to use the code which had been prepared for it at a great sacrifice of time and money. Mr. Gedge called attention to the imperfect postal and telegraphic communication afforded in sparsely-populated districts. He claimed that reasonable facilities should be afforded by the Post Office without making the individual pay for them. Mr. Hanbury, in reply to the question raised with regard to postal and telegraph facilities in country districts, especially in connection with the question of guarantees, said he had been asked by what authority the Post Office refused to extend those facilities in country districts without guarantees. It was at the discretion of the department to consider what was the true interest of the public service. If the department found that the cost would more than outbalance the public convenience, it could, no doubt, refuse facilities in particular districts. No doubt there were some portions of the country, like the Highlands and islands of Scotland, where special provision had been made for the fishing industry; but with regard to the extension of the telegraph service in the more thinly populated districts of the United Kingdon as a whole, the difficulty was that if the system of guarantees was abolished, the facilities would have to be extended to such an enormous extent, that they might swallow up a considerable portion of a large surplus. The system of guarantees did not press so unfairly as some hon. members supposed. It was a fair way to distinguish whether a district was sufficiently populated, or whether it used the telegraph and post office to such an extent as to make it remunerative. It was only where the extension of the telegraph service would be more costly than the returns from the service that a guarantee was required. The member for Glasgow had raised a formidable question regarding the telephones. The answer he gave two or three weeks ago was that in all cases where it was proved to the satisfaction—he supposed of the Postmaster-General—that any particular district was not being properly and adequately served by the National Telephone Company, the Post Office would exercise its undoubted right of working a rival system. What undoubtedly would happen would be that if the National Telephone Company failed to give adequate service in any district—and he took it that an inadequate service would be a too costly service—then the Postmaster-General would exercise his right to work side by side with the National Telephone Company. But the hon. member raised the further question whether the local authorities—the municipal corporation of Glasgow, for instance—should have the power to erect telephones within their own area on their own account. He thought it would be a very bad arrangement to have so many possible systems working side by side. The hon. member must recollect that what they all aimed at was that ultimately the whole service, both for the local areas and the great trunk lines, should fall into the hands of the Government. Nearly the whole of the hon. member's speech was intended to convey to the House of Commons an idea of the very cheap and efficient way in which the telephones would be worked if the municipal corporations were allowed to do it. It was quite possible that that might be the case, but as the telephones would in the course of a very few years fall into the hands of the Government, it would not be advisable, unless under exceptional circumstances, to agree to a system under which the municipal corporations would work them. With the exception of Glasgow, he did not know that there was any strong opinion on the part of municipal corporations in favour of taking over the telephone system in their areas.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St Pierre (1869, Anglo)	April 6th, 1895 ...	...
" " (P.Q.) ...	June 24th, 1895 ...	...
Brest-Penzance (P.Q.) ...	... ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Assab-Massowah. Telegrams between these places are forwarded by special boat ...	March 29th, 1896 ...	...
Guernsey-Jersey	April 8th, 1896 ...	...
Landlines.		
Communication with Matagalpa Provinces of Leon and Chinandega ...	Feb. 26th, 1896 ...	...
Trans-Continental line beyond Mazol (Mashonaland) Telegrams for Tohikwawa and Blantyre cannot be accepted.	March 12th, 1896 ...	...
Siberian lines between Blagoveschensk and Vladivastock ...	April 8th, 1896 ...	April 9th, 1896
Saigon-Bangkok ...	.. April 9th, 1896 ...	April 9th, 1896

The Japanese Government Cable Ship.—On Monday the cable ship, *Okinawa Maru*, designed and built by Messrs. Lobnitz and Co., Limited, Renfrew, ran her speed trials on "The Lights," attaining with ease the specified speed. The vessel is built to the highest class at Lloyd's, and is 290 feet long, 40 feet beam, and depth 24 feet 6 inches. She is provided with all the most modern telegraph cable fittings, which we describe in another place, and has three cable tanks. Twin-screw triple-expansion engines propel the vessel at a rate of 12½ knots per hour loaded, and although unfavourable wind conditions prevailed during the trials, this rate was exceeded. The coal trials also were completed to the full satisfaction of the inspectors. The system of electric light installed is one of the most complete; duplicate engines and dynamos, so arranged that each or

both are capable of lighting half or whole of the vessel at one time, supply the current. All lamps are wired from distribution boxes. There are duplex electric mast and side lights, a system of portable lamps for lighting up outside the vessel when picking up cable, and also a search light of 50,000 candle-power. The electrical engineers are Messrs. W. C. Martin & Co., Glasgow. Internally, the fittings are of a most luxuriant kind; the joiner and cabinet work is of the finest class, the saloon and officers' cabins being finished in mahogany with rich upholstery and hangings. Separate and well-appointed bath-rooms and lavatories are provided for the several officers, and for the crew. On the conclusion of the trials, the company on board were entertained to dinner by the builders. Among the guests were Captain Brown, Japanese Consul at Glasgow, Prof. Jamieson, of the Glasgow Technical College, Mr. Keijiro Okamato and Mr. S. Nishikato, the telegraph engineers and electricians, Mr. Cooper, Lloyd's surveyor, Mr. Robertson, surveyor, Mr. Jas. G. Reid, of Lobnitz & Co., &c. The vessel, calling at the Telegraph Construction and Maintenance Company's works to take in some 300 knots of cable, will proceed to Japan, there to lay the cable between that country and the Island of Formosa. She is supplied with Sullivan's universal galvanometer, as Messrs. Keijiro Okamato and S. Nishikato evidently know a good thing when they see it.

The City Telephone Tubes.—At the meeting of the Commission of Sewers on Tuesday, an application from the National Telephone Company for permission to lay cables under certain City thoroughfares, and in subways, was referred to the Streets Committee.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—June 1st. The municipal authorities of Prague are inviting tenders for the erection and equipment of a municipal electricity generating station in the town for electric lighting, power, and tramway traction purposes. Tenders are to be directed to the Stadrath der Haupt, Stadt Prague, Prague, Austria, from whom full particulars may be obtained.

Baildon.—Tenders are invited for the supply and erection of an electric lighting plant at Ferniehurst, Baildon (Shipley Station). The plant will comprise gas engine, dynamo, switchboards, storage battery, and wiring for about 180 incandescent lamps. Contractors are at liberty to tender for any portion of the work. Particulars, &c., from the engineer, Mr. A. Bernstein.

Bedford.—April 21st. The Urban Sanitary Authority invites tenders for the supply of vulcanised rubber cables. For further details see our "Official Notices."

Bedford.—April 21st. The Urban Sanitary Authority is inviting tenders for the construction in various positions in the borough of five underground sub-stations. Particulars obtainable at the Engineer's Office, Electricity Works, Bedford.

Belgium.—May 9th. Tenders are being invited by the Provincial Government authorities at Bruges, for the supply and installation of several electric water-level indicators. Tenders to be directed to the Gouvernement Provincial at Bruges.

Bray.—April 20th. Tenders are invited by the Commissioners for supply of cables, carbons, house wires, &c., for a period of 12 months. For further details, see our "Official Notices."

Brighton.—April 20th. The Corporation invites tenders for the preparation, supply, and delivery of cast-iron and drawn-steel bracket posts for suspending electric arc lamps for the Corporation. Details to be obtained of Mr. Francis J. Tillstone, town clerk, Town Hall, Brighton.

County Antrim.—May 1st. The Commissioners for the control of Lunatic Asylums invite tenders for the supply and erection of an electrical installation at County Antrim Lunatic Asylum.

Coventry.—May 12th. The Corporation invites tenders for the supply and erection of boilers and other plant for the boiler house, also steam engine, alternator, fittings, &c., for electric lighting. For further details, see our "Official Notices."

Eston.—May 1st. The District Council invites schemes for lighting the district by electricity, such schemes to embrace (*a*) plan and estimated cost; (*b*) annual working cost and maintenance. Particulars from the District Surveyor, Grangetown, Yorkshire.

France.—The French Admiralty authorities at Brest are at present inviting tenders for the supply of three steam dynamos intended for the electric lighting of the French cruiser *Gaulois*.

Hampstead.—April 27th. The Vestry invites tenders for the supply and erection of a 300 k.w. steam alternator, switchboard, steam and exhaust pipes, &c., for the Stone-yard Central Station. For further details, see our "Official Notices."

Lima.—June 1st. The Municipal Council is inviting tenders for the establishment and working of the electric lighting in the squares and streets of the city, with power to work the private supply under a 20 years' contract. Particulars to be obtained at the Peruvian Legation, 13, Comeragh Road, West Kensington, W.

London, S.E.—May 6th. Tenders are invited for the provision and fixing of electric bells, telephones, fire alarms, &c., at the Brook Fever Hospital, Shooter's Hill, S.E., for the Metropolitan Asylums Board. Particulars can be obtained at the chief offices of the Board on and after 16th inst. upon depositing £5.

Portugal.—May 6th. The Royal Company of Portuguese Railways is inviting tenders for the supply of material required in connection with the electric lighting installation. Particulars may be had from the offices of the company at 28, Rue de Chateaudun, Paris. Tenders to be sent to the Ingenieur Chef du Service des Magasins, Compagnie Royale des Chemins de fer Portugais, Santa Apolonia, Lisbon.

Rathmines.—April 20th. Tenders wanted for the electric lighting of the new Town Hall and offices for the Commissioners. Installation to consist of 250 lights, engine and dynamo. Also telephone and electric bell installations. Details at the office of the Secretary, Town Hall, Rathmines, Ireland.

Sunderland.—April 29th. The Corporation invites tenders for an evaporative tubular surface condenser with air and circulating pumps. For further details see our "Official Notices."

CLOSED.

Brighton.—Five tenders were sent in for the supply of 500 switches for the street lighting incandescent lamps. That of the Reason Manufacturing Company, of Brighton, at £487 10s. was accepted. Offers from firms outside the district were £368 15s.; £468 15s.; £750; and £806.

Harrogate.—For the electric wiring and fitting of the Prince of Wales Hotel, Harrogate, there were 35 tenders, that of the Liverpool Gas Fittings Company, Limited, for the sum of £1,293 was accepted. Mr. Walter Leake, of Manchester, is the consulting engineer.

St. Pancras.—The Vestry has accepted the tender of Messrs. Crompton & Co., Limited, at £6,456 17s., for the spare plant required for the King's Road electric lighting station. Messrs. Henley's Telegraph Company have written to the Vestry regarding an error which they have now discovered in their tender for cables, and asking to be allowed to send in an account for the difference between the amount stated and what was intended. The committee has resolved to take no action in the matter.

Sunderland.—The Corporation has accepted tenders for electric supply plant as follows:—T. Parker, Limited, two steam engines and continuous current dynamos, with steam and exhaust pipes, &c.; Babcock & Wilcox, Limited, two water-tube boilers; E. Green & Son, fuel economiser; H. Tomkinson, cast-iron tank.

Yarmouth.—The Council has accepted the tender of the General Electric Company for the supply of carbons during the ensuing 12 months. This company quoted the lowest price for satisfactory samples, *i.e.*, £6 12s. per 1,000 pair, and £3 3s. per 1,000 feet.

NOTES.

It Was Ever Thus.—"I think," says "Puzzled," in the *Financial News*, "the shareholders in Elmore's Foreign and Colonial Copper Depositing Company would like to know when the next meeting will be held. The last statement is only up to December, 1893, so that nearly two years and a half have passed without any information being given or any accounts published. What other company can equal this?" This is an old complaint, peculiar to the Elmore group. There are occasions when one considers no news good news, but it requires a long stretch of imagination to believe that such is the case in this instance. It is high time the shareholders took the matter into their own hands, though such unnecessary delay is but a repetition of the old Elmore management.

"An Unfortunate Shareholder" in Elmore's Wire Company writes to the same paper asking the secretary of the company to inform the shareholders as to the present state of the concern. "Is it still the old cry of not enough capital, and are we never to receive a dividend? In other words, are we to look on our money as lost?"

The Institution of Electrical Engineers.—At a students' meeting, to be held in the library of the Institution, 28, Victoria Street, on Friday, April 24th, at 8 p.m., the following paper will be read:—"Underground Conductors," by E. Ray and V. Watlington, students.

The Management of Electric Lighting Plant.—Writing to the *Leeds Mercury*, "J. L." says :—

The management and control of electric generators is attended with such a strain on the watchful attention of the electrician in charge, if the works are of any considerable size, that it is found necessary to change the men at frequent intervals. This arises from the absolute necessity, often under great difficulties, of maintaining the balance between demand and supply. In the City of London supply station, a cloud passing over the face of the sky, or the presence of the least fog, often puts on an instantaneous load, equal to 200 or 300 horse-power, during daylight hours, and an emergency staff of men off duty, but within instant call, are always in readiness to meet such demands. Then there is always a sudden demand for supply when large numbers of lights are switched on together, and as sudden a cessation of demand when they are switched off. The eye of the electrician, therefore, has to be constantly watching his indicator, and regulating the working of his dynamos to the demand made upon them, or serious results would instantaneously ensue. The awkward part of it is that when an accident occurs through inattention, it comes without any warning, and a whole town may be enveloped in darkness by the slightest hitch in the machinery. This really happened a few weeks ago to a township in Westmoreland, though not through any fault of the engineer. Some men had been cutting a drain in a street which intersected the wire conducting the electric current, and they managed to damage it to the extent of cutting about half through, and stupidly covered it up without saying anything. All went well for a time, no indication being given of a deficiency of supply until the wire gave way in a moment, and the whole town was in darkness. It can, therefore, easily be understood what responsibility rests in the engineer of the works, nor need it be a matter of surprise if the men become nervous and excitable under the strain. Only the other day the manager of one of these large plants, going there to see that all was right, found the electrician in a nervous and excited state, under the impression that some thieves or burglars were on the premises, which, of course, was an entire hallucination.

X Rays Reflected from Platinum.—It is stated that Prof. Ogden N. Rood, of Columbia College (America), has reflected the X rays from platinum, his estimation of the amount being $\frac{1}{1260}$th part of the rays of incidence.

Institution of Mechanical Engineers.—On Friday evening, May 1st, a paper on "Steel Steam Pipes and Fittings, and Benardos Arc Welding," will be read by Mr. S. MacCarthy.

Aids to Scientific Research.—£500 has been granted to the St. Petersburg Medical Academy for carrying out X rays experiments.

Edison Works Australia.—We have long been impressed with the importance of the field for electrical enterprise that is gradually opening out in Australia and New Zealand. Edison has, according to the *Sydney Telegraph*, commenced operations in that immense district, and doubtless being convinced that matters should be stirred there as soon as possible, he has formed, or has arranged with others to form, the Australian Edison Electric Company, for the purpose of handling the whole of his inventions throughout Australia.

University College, London.—The Council has made the following, among other appointments :—Prof. Carey-Foster is reappointed Quain Professor of Physics, and the title of assistant professor has been conferred on Mr. G. U. Yule and Mr. A. W. Porter, the former being assistant to the Professor of Applied Mathematics, and the latter to the Professor of Physics. Sir Douglas Galton will represent the College at the celebration in June next of the jubilee of Lord Kelvin's professoriate in the University of Glasgow.

Aluminium in the United States.—The *Revue des Sciences*, in the course of an article on aluminium, gives some very striking statistics to show how rapidly the production of it has increased in the United States since 1883, in which year it did not exceed 83 lbs. In 1886 the production had increased to 3,000 lbs., in 1889 to 47,468 lbs., in 1891 to 150,050 lbs., and in 1893 to 339,629 lbs., while in 1894 the total was 550,000 lbs. The *Iron Age* puts the production for 1895 at 850,000 lbs., and estimates that this year it will not fall short of 6,000 lbs. per diem.

The Rumoured Traction Scheme for London.—The immense traction scheme to which we referred last week, must not, at the present stage, be taken too seriously, for we understand that beyond the mere formation of a syndicate of financiers and tramway experts, nothing definite has been done. The promoters intend, according to present reports, to endeavour, by arrangement with the London County Council and the various companies concerned, to effect a purchase of all the existing tramway systems in London, change the motive power from horses to electricity, using an underground conduit system, the particulars of which are not yet disclosed, lay down extensions also electric, and make the network of street railroads more complete. The entire service would be controlled by one great tramway trust to be formed later. However, we need say little about the matter at present, for the scheme is only a paper one, and may yet take the course of rejected MSS. As a whole, the proposal is bold and daring, and if it turns out to be practicable, either in its present elaborate, or some modified form, the electrical world should reap a good harvest, and it will be welcomed by those having the interests of electric traction at heart.

Society of Arts Competition.—The Council of the Society of Arts offer the Fothergill Prize of £25 and a silver medal for a paper on "The Best Means of Effectually Preventing the Leakage of Current to Earth in Electrical Installations from Generating Heat and Setting Buildings on Fire." The paper should consist of about 8,000 words, and be written with a view to being read and discussed at an ordinary meeting of the Society. Papers submitted for the prize must be sent to the secretary (Sir Henry Trueman Wood) on or before October 1st, 1896. Each paper must be typewritten, and bear a motto, the name of the writer being enclosed in a sealed envelope with a similar motto. The judges will be appointed by the Council. The Council reserve the right of withholding the prize, or of awarding a smaller prize or smaller prizes, if in the opinion of the judges no essay deserving the full award is sent in.

Accidents Due to Gas.—A gas explosion occurred at Church Street, Berwick, a few days ago, an old lady being injured by fire and shock.

A house in Prince's Street, Portsmouth, was wrecked recently by a gas explosion, a servant being badly injured.

At Thames Baptist Chapel, Wallingford, on 8th inst., a gas explosion occurred, wrecking the pews and flooring in the whole of the centre of the chapel, and breaking several windows.

Last Saturday one man was killed and another seriously injured by a gas explosion at the Huddersfield Corporation Gasworks.

At Prince's Street, Portsmouth, on 5th inst., a gas explosion injured a servant and two children, brought down the ceiling, and blew out the windows.

X Craze.—"Wilhelmina," in *Photography*, breaks forth as follows :—

X-actly So.

The Röntgen rays, the Röntgen rays—
What is this craze?
The town's ablaze
With this new phase
Of X rays ways.

I'm full of daze,
Shock and amaze;
For nowadays
I hear they'll gaze
Thro' cloak and gown—and even stays!
These naughty, naughty Röntgen rays!

The Queensland Appointment.—We understand that the appointment of electrical engineer to the Queensland Government has been secured by Mr. Hesketh, electrical engineer to the Blackpool Corporation. Mr. Hesketh, who is to sail at an early date, has our congratulations. We have also pleasure in extending our good wishes to Mr. Hesketh upon the occasion of his marriage, he having on Tuesday married Miss Hinnell, daughter of the Town Clerk of Bolton. He expects to proceed to Queensland in about five weeks.

Lectures.—On 11th inst., at Birmingham, before the Association of Mechanical Engineers, a paper was read by Mr. T. Meacock on "The Application of Electricity to Motive Power Purposes." Tramcar propulsion, factory driving, and other applications were dealt with, an electric tramway conduit, invented by the author of the paper, being fully explained.

Before the Liverpool Architectural Society on Monday, Mr. T. L. Miller, M.I.E.E., read a paper on "The Application of Electricity to Lighting and Power Purposes."

Before the Cleveland Institute of Engineers, on 13th inst., Mr. Philip Dawson read a paper on "Electric Tramways," and gave his experiences of Continental, American, and the existing British electric tramways. The same evening, Mr. A. S. Keith read a paper on "The Economical Uses of Blast Furnace Gases."

Superfetation.—The effect of a Saturday *conversazione* on our good friend of *Lightning*, seems to last over a fortnight. Here are the exact words which "gave the impression" that Mr. Brown's former letter was sent to the ELECTRICAL REVIEW. "Mr. C. Brown sends a very indignant letter, complaining of the treatment his former letter on superheating (which was not intended for publication) has received from the ELECTRICAL REVIEW." And now, forsooth, our wily friend tries to escape by retorting: "We did not say to whom the former letter was sent."

The Uses of Röntgen Rays.—The *Pall Mall Gazette* says that some sensation has been occasioned in American scientific circles by a claim put forward on behalf of Profs. Pratt, Wrightman, and Bennett, of the Medical College, Chicago, to the effect that they have discovered that the Röntgen rays are able to kill the bacteria of cholera, diphtheria, pneumonia, influenza, glanders, typhoid, tuberculosis, and anthrax. Details are awaited with much eagerness.

Institution of Junior Engineers.—This evening, at 8 p.m., Mr. Hunter's paper on "Dredgers" will be read. On Saturday, April 25th, the members will visit the offices of the *Daily Chronicle* and *Lloyd's Weekly Newspaper*, to view the printing machinery, electric lighting, &c. The summer meeting in Scotland, with the assistance of so genial a president as Mr. Archibald Denny, of Dumbarton, should be a thoroughly enjoyable outing.

Personal.—It is announced that Lord Rayleigh has been appointed a foreign member of the Copenhagen Academy of Science.

We hear that Mr. Edward Stallibrass, who has for some years been connected with submarine telegraphy, is leaving this country shortly to take up a position in connection with the Mombasa and Uganda Railway. Mr. Stallibrass has our good wishes, though we cannot but regret his departure from this country.

Incandescent Lamp Regulator.—With reference to the notice of the Edison and Swan switch lamp in our article last week on "The Incandescent Lamp Regulator of Macfarlan Moore," we may add that the construction of the lamp is such that the two filaments, 8 and 16 C.P., can be switched to 8, 16, or 24 C.P., and that the energy used at either of these is in proportion to the candle-power both with alternating or direct current.

Appointment.—There were 19 applications for the post of consulting electrical engineer to the Ashton Town Council, and upon the recommendation of the Electric Lighting Committee Mr. Clirehugh has been appointed

Mr. Harold W. Woodall has been appointed assistant electrical engineer at Hampstead central station, in the place of Mr. W. Bathurst resigned.

Institution of Civil Engineers.—We understand that the new measures proposed for increasing the number of Council, the method of nomination, and that of voting, were all carried through in a few minutes at the meeting held on Wednesday afternoon. We refer at some length to the accepted reforms on page 500.

Presentation.—Mr. W. B. Edgar has, on the occasion of his leaving the Crichton Royal Institution, Dumfries, been presented by the electrical staff and a few friends with a handsome gold chronograph. As Dr. Bottomley's assistant, he has acted as resident engineer during the progress of the work, and leaves to join the staff of Messrs. Johnson and Phillips, Charlton, Kent.

Accident.—We learn from a correspondent that Mr. Alfred Dickenson, the manager of the Birmingham Tramway Company, was early last week thrown out of his trap by a restive horse. We are pleased to learn that he is now progressing favourably, though at first it was thought Mr. Dickenson could not survive.

The New Photography.—At the Vestry Hall, Hampstead, on Tuesday last, an experimental lecture on "Photographing the Invisible," was given by Mr. Wm. H. Marshall (electrical engineer). The lecture was illustrated with lime light views.

CITY NOTES.

Telephone Licenses.

A PARAGRAPH in the Oriental Telephone and Electric Company's report shows the precarious nature of telephone licenses. As will be seen in the report which is reproduced, the company's license from the Government of Ceylon expired on December 31st, and the Government refused to extend it. We have, of course, no knowledge of the terms under which the license was held, nor do we know anything about the business built up or the quality of the plant, but after considerable negotiation, including an appeal to the Secretary of State for the Colonies, the company has accepted £2,500, which is stated to be equal to one-half of the capital expended on the construction. Without venturing to express an opinion on the matter as a whole, the Government of Ceylon will at any rate reap the advantages of the pioneering efforts of the Oriental Company; these may not be worth more than the Government has paid, but it is none the less unsatisfactory from a shareholder's point of view.

The Yarmouth Accounts.

THE result of the first complete year's working ought to be satisfactory to the Corporation. The deficiency to be met by the rates is £766, which is not considerable when it is remembered that a fairly extensive system of public lighting is in vogue. The gross profit on the year's working is £149 7s. 6d., and with the low cost of production during 1895, it is reasonable to assume that there will be considerable improvement this year. Altogether, Mr. Ranken, the borough electrical engineer, is to be congratulated on the first year's working:—

	1893.	1894.	1895.
Total capital invested	—	—	£20,232
Number of units sold	—	—	117,700
Number of lamps connected ...	—	—	—
Revenue from sale of current...	—	—	£1,870
Net revenue	—	—	£149
Average price obtained per unit	—	—	—

Cost of Production.	£	s.	d.	Per unit.
Coal	635	0	0	1·33d.
Oil, waste, water, and engine room stores	151	0	0	·32d.
Salaries and wages at generating station	298	0	0	·62d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	95	0	0 (Works' cost 2·47d.)	·20d.
Rates and taxes	59	0	0	·12d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	279	0	0	·58d.
Depreciation of buildings and plant account	—			—
Sinking fund account	—			—
Total	£1,517	0	0	3·17d.

Richmond (Surrey) Electric Light and Power Company, Limited.

Without going into the past history of this company, it is hardly necessary to say that the early stages of the company's existence were marked with exceptional difficulties. The County of London and Brush Provincial Company have now obtained a controlling interest in the concern, and no doubt their methods will have a beneficial effect on the company's career. Indeed, we may take as evidence of the prosperity that awaits this company the revenue account for 1895, which shows a profit of £230 2s. 1d., against a loss of £978 19s. 8d. in 1894. There have been a good many legal charges arising out of disputes with the contractors, but these seem to be now finally adjusted, and an item of £131 16s. 2d. for legal expenses appears in the present accounts, though liability for the greater part of these had been incurred in the previous year. A further sum of £2,906 13s. 7d. has been expended on capital account for mains and meters, and for electrical instruments in the station. The total number of lamps connected on December 31st last was equivalent to 5,486 8-C.P. lamps, being an increase of 1,746 since December, 1894, and a considerable number have been since applied for and connected in the enlarged area of supply in which mains were laid last year. It is satisfactory to observe that the company is working in harmony with the Richmond Corporation, for consent has been obtained by the company for power to still further increase the area of supply.

The following table gives the cost of production, which, in the next year or two, will be no doubt considerably reduced:—

	1893.	1894.	1895.
Total capital invested	—	—	£38,320
Number of units sold	—	—	80,456
Number of lamps connected ...	—	—	5,486
Revenue from sale of current...	—	—	£2,318
Total working costs	—	—	£2,202
Net revenue	—	—	£230
Average price obtained per unit	—	—	6·95d.

Cost of production.	£	s.	d.	Per unit.
Coal	447	0	0	1·34d.
Oil, waste, water and engine room stores	141	0	0	·42d.
Salaries and wages at generating station	728	0	0	2·18d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	69	0	0	(Works' cost 4·15d.) ·21d.
Rates and taxes	165	0	0	·50d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	652	0	0	1·96d.
Depreciation of buildings and plant account	—			—
Renewal fund account	—			—
Total	£2,202	0	0	6·61d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	2,318	0	0	—
Meter rents	107	0	0	6·95d.
Other items	6	0	0	—
Total	£2,431	0	0	6·95d.

A meeting of the company was held yesterday at Moorgate Court, but the proceedings were conducted in private.

County of London and Brush Provincial Electric Lighting Company, Limited.

The Right Hon. Lord Rathmore (chairman) presided over the second ordinary general meeting of the shareholders of the above company, held at Winchester House, E.C., on Monday afternoon, and in moving the adoption of the report, said they might feel reasonable satisfaction as to the past and increased confidence as to the future. During the period dealt with by the report, they had had to deal with some difficulties and submit to some disappointments and delays, such as he supposed must be inevitable in the earlier stages of such an undertaking. Still, already they had a considerable measure of success to present to them, and although he was never one to take a too glowing or rosy view of the situation, yet speaking in all seriousness and moderation, they might well congratulate themselves on the fact that although established but two years, they stood that day on solid ground. They had established and possessed a large and important business, and had good grounds to anticipate that ere long the company would prove to be a prosperous and very lucrative undertaking. Their position was that the net revenue of 1895 proved to be sufficient to pay in full the dividends upon the preference capital, and to carry forward a substantial balance. That revenue had been earned under circumstances of some difficulty, which although of a temporary and accidental kind, still was such as to give them a good deal of trouble. With respect to the balance-sheet, the item of £34,000 loans against security, referred to a loan from the bankers in anticipation of the calls upon the preference and other issues, and also as against the security of certain investments which the company had made in quoted stocks. It was thought inadvisable to sell them at the time, because they were rising in value, but they had since been sold at considerable profit, and would go into the accounts of the present year. To give honour to whom honour was due, he might say in that connection they were greatly indebted to the deputy-chairman, Mr. Braithwaite. The item of sundry creditors, £1,260, had almost all since been paid. On the assets side of the balance-sheet they would see £75,911 capital appropriated for the St. Luke's order, and £40,388 for the Wandsworth lighting order. There was an item of £4,462, sundry debtors, which represented debts due from the sub-companies, and for interest and dividends. Practically, all those had been received since the beginning of the year. He would now deal with the work of the company as far as London was concerned. With regard to St. Luke's and Clerkenwell, they had been confronted with difficulties which they had no reason to anticipate. In the first place, the London County Council took objection to their stations; there was a strike with the workmen of the contractor, which lasted a considerable time, and seriously interfered with the business; and they had also had some difficulties with regard to their street boxes. However, all those difficulties had been overcome; the whole of the work had been completed, and connections had been made with the consumers' premises. The remainder of the connections were being pressed forward as fast as possible, and he might tell them that the amount of current supplied in the first quarter of that year was almost equal to the whole amount supplied during the past year, and it was anticipated that at least about five times the amount of current would be supplied during the present year as was supplied last year. The station buildings were proceeding, and they trusted would be in readiness for the winter lighting with excellent machinery, and in that station they would have one of the best generating stations which existed in the metropolis, the cost of which would compare favourably with any other station of a similar character. At Wandsworth they had had the disadvantage of having to deal with difficulties raised by the local authorities as regarded the street work. That involved them in litigation, which was rather lengthy, as all the questions had to be threshed out before the Board of Trade, and also in the High Courts of Justice. They could not blame themselves for that, because every question raised was ultimately decided in their favour, and now the street work at Wandsworth was approaching completion on the plans, and according to the system, they originally decided upon. Their station buildings were also advancing, and they had almost finished what he thought would be a handsome generating station at the spot where the River Wandle joined the Thames. Therefore, for the winter lighting, they hoped to have two large generating stations—one on the north and one on the south of the Thames—built and equipped with every modern improvement, having a combined power of supplying some 90,000 lamps, a power capable of being easily doubled, simply by laying down additional plant, and drawing in additional cables for the supply of their customers, and he thought, under those circumstances, that in spite of all the difficulties and delays, they might fairly congratulate themselves on the satisfactory condition in which their venture in lighting St. Luke's and Clerkenwell on the one side, and Wandsworth on the other side, now stood. Since the report had been printed, the provisional order for St. Olave's had been confirmed by Parliament, and received the Royal assent. The Clerkenwell Vestry had given their assent, and they were in hopes of securing some neighbouring districts, which could be easily lighted from one generating station. As to the provinces, at Bournemouth the business had to some extent been interfered with by the conveyance of the machinery from the old station to the new, which had entailed rather a heavy cost; but notwithstanding, the gross revenue had increased during the year by £600, and the working expenses were a trifle less. They might confidently expect, with the enlargement of the plant which had been made, and also by the improvements which had been introduced, that the cost of production would be considerably reduced in the present year, and that the net revenue would be increased. The cost of production in 1895 was ¾d. per unit less than in 1894, and the amount of current supplied in the first quarter of 1896 exceeded by about 16 per cent. the amount supplied in the corresponding quarter of 1895. At Dover the large generating station had been completed some time, and they had been able to supply an uninterrupted current to their consumers. Up to the present time the number of connections made was about 4,800 8-C.P. lamps, and that number would probably be doubled by the end of the year. At Windermere they had received the assent of seven out of nine local authorities to the provisional order, and he was sorry to say the two bodies still withheld their assent, and therefore they had not made much progress. With respect to Richmond, in Surrey, last year he told them they had just acquired the controlling influence in the Richmond Electrical Lighting Company, and he anticipated favourable results from that investment. He was glad to tell them that it had come out better than anticipated, and already they had turned the corner, for instead of a loss of nearly £1,000, which was sustained in 1894, there had been a profit during the year 1895, and certain charges had been paid off out of revenue. At present the number of lamps applied for at Richmond was equivalent to 5,913, and 5,800 were connected with the company's mains. The units sold in the quarter just ended exceeded the numbers sold in the corresponding period of 1895 by about 19 per cent., but still their expenses were considerably lower. Further extensions were being pressed forward to meet the wants of consumers, and they could confidently expect that before long Richmond would provide a handsome profit. Their manager, Mr. Lawson, had been struck down with a severe fever, owing, no doubt, to his over zealous exertions in the

performance of his duties, and they would have been seriously embarrassed by the loss of his presence had not Mr. Garcke stepped in. They were glad to see Mr. Lawson now restored to health, and they were also to retain Mr. Garcke's advice, as he had accepted a place on the board. They looked back with considerable satisfaction on the past year's working, and looked forward to the future with increased confidence. It was in the nature of such a company as that, that in the earlier stages expenditure must be large, and the revenue comparatively small. It required money and time to build generating stations and equip them with machinery, and lay down miles of cables in the streets; and it took time, when all that was done, for the inhabitants to become customers. But in a short time that would be reversed. They had already reached firm ground in their undertaking, and as time went on they would find capital expenditure diminish and revenue increase. They had no doubt that they would be able to maintain the dividends on the preference capital, and confidently believed that before long the ordinary shareholders would also reap their reward in substantial and comfortable dividends.

Mr. Braithwaite seconded the motion for the adoption of the report, and it was carried unanimously.

The retiring directors and auditors having been re-elected, a hearty vote of thanks to the chairman and board concluded the proceedings.

The Indo-European Telegraph Company, Limited.

The directors' report for 1895, to be presented at the meeting at Winchester House on 29th inst., states that the revenue from all sources for 1895 amounted to £123,734 11s. 7d., as compared with £119,117 18s. 3d. for 1894, showing an increase of £4,616 13s. 4d. The expenses were: On commercial and general account, £34,749 5s.; on maintenance account, £33,071 5s. 4d.; total, £67,820 10s. 4d., as against £64,838 13s. 1d. for 1894, an increase of £2,981 17s. 3d. Deducting the above expenses, taking credit for £5,789 2s. brought over from 1894, and debiting income-tax, there remains the sum of £59,371 17s. 11d. From this amount £10,000 has been placed to reserve, and that sum, together with £10,625 amount of interim dividend, have to be deducted, leaving a balance of £38,746 17s. 11d. The directors now propose the declaration of a dividend for the six months ending December 31st of 17s. 6d. per share, making, with the dividend already paid, 6 per cent., and a bonus of 20s. per share, both free of income-tax, making in all 10 per cent. for the year, carrying forward £6,871 17s. 11d. to the credit of 1896. There will be a conference this year of the States parties to the Telegraph Convention to consider the rules, regulations and tariffs of the same. The conference will assemble in June next at Buda Pesth, and the companies are invited to be represented. The following directors retire by rotation, and offer themselves for re-election:—L. Delbrück, Esq., and C. W. Earle, Esq. The transfer books will be closed from the 15th to the 29th inst., both inclusive. The auditors, Messrs. C. F. Kemp, Ford & Co., chartered accountants, retire, and offer themselves for re-election.

The Oriental Telephone and Electric Company, Limited.

The report of the directors for the year ended December 31st, 1895, to be presented at the second ordinary general meeting of the company, to be held at the Cannon Street Hotel, London, on Wednesday, April 22nd, 1896, at one o'clock, p.m., states that the revenue account for the year shows a balance to credit of £8,675 2s., which has been transferred to profit and loss. Including the sum of £706 5s. 3d. brought forward from 1894, there is an amount of £9,381 7s. 3d. available for disposal. The company's license from the Government of Ceylon expired on December 31st, the Government refusing to extend it, having resolved to work the telephones through their telegraph department. That Government having declined either to purchase the company's plant, or to compensate the company for the loss of its business, representations were made to the Government of Ceylon which resulted in a very inadequate offer being made for the mere value of the plant. This offer the directors declined. The board then appealed again to the Secretary of State for the Colonies; and, ultimately, rather than sacrifice the property of the shareholders altogether, they agreed to accept a sum of £2,500, equal to about one-half of the capital expended on the construction. Although the transaction was only completed in January of the present year, the directors are advised that this item in the capital account must be shown in the accounts now presented. The directors, out of the revenue of the past year, recommend a dividend of 5 per cent., free of income-tax, which will absorb £8,575 4s., and leave £806 3s. 3d. to be carried forward. The revenues of the Indian Subsidiary Companies continue to improve, although the dividends received by this company are approximately the same as those received last year. The expenses of the Bengal Company for the past year were temporarily increased, owing to a change of manager. The Bombay Company has, after payment of the same dividend as in the previous year, carried to reserve and depreciation undivided profits to the extent of Rs.23,000. The Telephone Company of Egypt has declared a dividend of 6 per cent. as usual on the preferred shares. The China and Japan Telephone Company has had a better year, and the accounts point to an increased surplus over the previous year, after payment of debenture interest. The directors have agreed to extend the time for the payment of the debentures held in this company, which fell due on December 31st last, for a further period of five years. The turn-over by the electric lighting branch in India has more than doubled that of the preceding year, but the expenses incident to sending out an assistant and advertising have again caused a loss on the year's operations. The directors believe there is room for development in this branch, but have deemed it desirable to write off all initial expenses such as those referred to which are usually spread over a term of years. Under article 65, two directors retire at the present meeting, and these are Mr. B. St. John Ackers and Mr. G. B. Frost, both of whom, being eligible, offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and offer themselves for re-election.

Chelsea Electricity Supply Company Limited.

An extraordinary general meeting of the members of this company was held at the registered offices, 19, Cadogan Gardens, London, S.W., on Wednesday, 15th inst., when the following resolution was passed:—"That the capital of the company be increased by the creation of 20,000 ordinary shares of £5 each, and that the provisions of Article 4 of the articles of association of the company shall not apply to such new shares."

The Chairman (Mr. Courtenay) said that with the growing demand for current in excess of the present capacity of the plant, the capital outlay must increase; but the experience gained enables the outlay to be made to the best advantage, and in the most economical manner. The total number of lamps added this year, up to the end of March, is 4,573, as against 1,098 last year, or more than four times as many in the first three months. Formal application had been made to the Board of Trade, under our provisional order, for the whole of the remaining portion of the parish of Chelsea, and as it is unopposed, they expected that the application would go through in due course. This comprises the extensive district running from Battersea Bridge, along Beaufort Street, and by the Fulham Road to the western boundary of the parish. The rapid increase in the demand for current in the present area, and this large addition to the district supplied by the company, necessitate the immediate building of a new generating station which will be erected on the company's own freehold property, and adjacent to the existing station in Manor Street, and also sub-stations for the distribution of the current. The site selected for the new generating station has space for plant having capacity for running some 50,000 8-C.P. lamps at one time, but it is only intended to erect and equip works in accordance with the demand as it arises, though the complete arrangement has been designed. The works and plant it is proposed at once to erect and equip will furnish current to about 25,000 8-C.P. lamps fixed, and then there will be the mains and street work, which latter will be laid down with a view to carrying a larger demand as it arises. I desire to call your attention to the fact that the works' costs have considerably decreased as the number of units sold have increased. During the last two years there has been a reduction in works' costs of 26 per cent., and an increase in the demand for current during the same period of 43 per cent., which agrees with the experience of other metropolitan companies.

The resolution was agreed to after a few questions had been asked.

A further meeting, of which due notice will be given, will be called to confirm the resolution, so as to make it a special resolution.

Eastern Extension, Australasia and China Telegraph Company, Limited.—The accounts to December 31st last show, subject to audit, a balance profit of £210,579, after payment of three interim dividends. The directors now propose to distribute on the 30th inst. a final dividend of 2s. 6d. per share, together with a bonus of 4s. per share (or 2 per cent.), making a total distribution of 7 per cent. for the year 1895. The share register will be closed from the 22nd inst. to the 29th inst., both days inclusive.

Great Northern Telegraph Company, Limited.—The net receipts during 1895, including the balance brought forward from 1894, amount to £381,583 2s. 8d. Deducting £85,916 13s. 4d. towards interest on, and amortisation of, debentures, and interim dividends (already paid), £75,000, the board propose to distribute the balance as follows:—Final dividend (making the total dividend for the year, 10 per cent.), £75,000; reserve and renewal fund, £83,333 6s. 8d.; pension fund of the staff, £2,777 15s. 7d.; directors' remuneration, £1,500; balance to be carried forward, £58,055 7s. 1d.

In re Woodhouse & Rawson United, Limited.—Mr. G. S. Barnes, the official receiver and liquidator, notifies that a meeting of the principal unsecured creditors in the above matter will be held at 33, Carey Street, Lincoln's Inn, London, W.C., on Tuesday, April 21st, at 12 o'clock at noon. The meeting will consider what action (if any) should be taken in the interests of the unsecured creditors, in connection with certain claims, which counsel has advised that the liquidator can enforce against the directors and auditors, and which claims are now offered for sale by tender.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending April 12th, 1896, were £868; week ending April 14th, 1895, £779; increase £89; total receipts for half-year, 1896, £14,339; corresponding period, 1895, £14,362; decrease, £23.

The Liverpool Overhead Railway Company. The receipts for the week ending April 12th, 1896, amounted to £1,469; corresponding week last year, £1,343 increase, £226.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 10th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,375.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation April 8th.	Closing Quotation, April 15th.	Business done during week ended April 15th, 1896. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	10½— 11	10½— 11	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	48 — 50	49 — 51	50¼	49
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	91½— 92½	92 — 93	93	91½
2,993,560£	Do. do. Defd.	Stock	...	...	...	9½— 10	10½— 10⅝	10⅝	9⅝
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	...	14¼— 14¾	14½— 14¾	14⅝	14 5/16
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	112 —116	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3 — 3½	3 — 3½	3⅜	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —170	160 —170	167	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	...	1/16— 3/16	1/16— 3/16	1/8	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½— 13½	12½— 13½	13½	12⅝
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½— 21½	20½— 21½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	10⅜	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	106 —109 %	106 —109 %	...	...
60,710	Direct United States Cable, Ltd.	20	2½% §	2 %	...	9½— 10	9½— 10	9⅞	9½
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	...	17 — 17½	17 — 17½	17 7/16	17⅛
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	...	18 — 18½	18 — 18½	...	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	105 —108	106 —109	106½	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	130 —133	130 —133	132½	129
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17⅞— 18¼	17⅞— 18¼	18⅛	17⅞
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	101 —105	101 —105	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	102 —105	102 —105	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	128 —131	128 —131	130½	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 —105	101 —105	...	...
107,600£	Do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	105 —108	105 —108	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	112 —115%	112 —115 %	112	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅜% §	4½%	...	10½ — 10⅝	10½— 11	10½	10⅜
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	...	16¾ — 17¼	16¾ — 17¼	17⅛	16⅝
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	8⅝%	10 %	22⅞ — 23½	23 — 23½	23½	22⅝
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	48 — 51	49 — 52	52	50⅜
100,000£	London Platino-Brasilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	107 —110	108 —111	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5½%	6⅞— 7	6⅞— 7⅛	7 1/16	6 15/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	17⅛	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16½ — 17½	16½ — 17½	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅝— 6⅞	6⅝— 6⅞	7	6 15/16
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	106 —109	106 —109	106½	107⅛
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4½%	5 %	1/16— 1/8	1/16— 1/8	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	108 — 111	108 —111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	...	5 — 6	5 — 6	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	134 —139	133 —138	...	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	...	3½ — 4	3½ — 4	3 9/16	...
146,732£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	96 —101	96 —101	100	98
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	...	5½— 6½	5½— 6½	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	101 —104	102 —105	104	...
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	1 — 2	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	95 —100	95 — 100	99	...
64,248	Western and Brasilian Teleg., Ltd.	15	2½%	3 %	...	8½— 9	8½— 9	8⅞	8 13/16
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6¼— 6⅝	6¼— 6⅝	6⅝	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	...	2¼— 2⅝	2¼— 2⅝	2⅝	2½
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	...	103 —107	104 —108	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	...	103 —107	104 —108	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅜%	⅜%	...	1 — 1¼	1 — 1¼	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	10⅜ — 11¼	11 — 11½	11¼	11 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9 — 10	9½ — 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	113 —118	113 —118	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	7½— 7⅝	7½— 7⅝	7⅝	7½
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7½— 8	7½— 8	7⅝	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4 %	116 —119	116 —119	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14½ — 15½	14½— 15½	15⅝	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 17	16 — 17	16¾	...
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	134 —138	134 —138	...	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	*nil*	8 — 9	8 — 9	8 1/16	...
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	6 %	12½— 13½	12½— 13½xd	...	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5½%	...	7⅝ — 7⅞	7⅝— 7⅞	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	...	12⅝ — 13½	12½— 13	13½	12 15/16
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	118 —120	118 —120	119½	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	8¾ — 9½	8¾ — 9½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	9⅝ — 10½	10 — 10½	10⅜	10 1/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9⅝ — 10½	9⅝ — 10½	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	9¾ — 10¼	9¾ — 10¼	10	9 13/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, April 8th.	Closing Quotation, April 15th.	Business done during week ended April 15th, 1896. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	S	5 % §	2½%	...	1½ — 1⅝	1½ — 1⅝	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1⅝ — 1⅞	1⅝ — 1⅞	1⅞	...
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	110 —113	111 —114	112½	...
830,000£	City and South London Railway	Stock	1¹⁄₁₆%	1¹⁄₁₆%	1⅛%	40 — 42	40 — 42	41	40¼
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	...	2¼ — 2⅜	2¼ — 2⅜	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	...	1¼ — 1⅜	1¼ — 1⅜	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	...	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	...	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	1⅛ — 1⅜	1⅛ — 1⅜	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2¼ — 2⅜	2¼ — 2⅜	2⅜	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅝ — ¾	⅝ — ¾	¾	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅝ — ¾	⅝ — ¾	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil*	...	¼ — ½	¼ — ½	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	...	9½ — 10½	9½ — 10½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	16½ — 17½	16½ — 17½	17⅛	16¾
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	16½ — 17½	16½ — 17½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	107 —112	107 —112	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	20 — 21	20½ — 21½	21	20⅛
200,000£	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	... ...	... ...	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2½%	14 — 14½	14 — 14½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16⅜ — 16⅞	16⅜ — 16⅞	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	38 — 41	38 — 41	39½	39
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	8¼ — 8⅜	8¼ — 8⅜	8¹¹⁄₁₆	8⅝

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—6%; 1891—7%; 1890—5%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6¼.

Electric Construction Corporation, 6 % Debentures, 102—105.

House-to-House Company (£5 paid), 3¼—3½.

Do. do. 7 % Preference, of £5, 8—8¼.

Do. do. 4½% Debentures of £100, 109—111.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 8¼—8⅜; 1st Preference Cumulative 6 %, £5 (fully paid), 7⅛—7⅜.

Liverpool Electric Supply, £5 (fully paid), 7⅜—8¼.

London Electric Supply Corporation, £5 Ordinary, ⅜—⅝.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7¼—7⅜.

Bank rate of discount 2 per cent. (February 22nd, 1894).

THE GREAT CYANIDE CASE IN THE TRANSVAAL.

We shall soon hear the result of the great cyanide case which was conducted before Chief Justice Kotze, Justices Jorissen and Morice, in the Transvaal, where it has a great deal more importance than in London. There is no real mining industry in this country, where two actions have been tried; but for gold and diamonds, Johannesburg, the Rand, and the Transvaal would hardly be known, and for many mining people, the Jameson trial is perhaps much less interesting than the Cyanide case.

We cannot publish the whole of this long affair, and shall therefore give only the more interesting extracts. The hearing commenced on Feb. 18th, in the Second Volksraad Hall at Pretoria, it having been found that the accommodation in the High Court was much too limited.

"The legal element was strongly represented, there being something like a dozen advocates and about the same number of attorneys engaged in the case. Among those present in the body of the hall were Mr. W. W. Webster and Mr. J. M. Buckland, the representatives of the African Gold Recovery Company, Mr. John S. MacArthur and Dr. Robert W. Forrest, two of the patentees of the MacArthur-Forrest process, Mr. Charles McCulloch, Chairman of the African Gold Recovery Company, Professor Crookes and Professor Tatlock, who went out from England specially in connection with this case. Several witnesses were also present, anxiously waiting to be called, and the representatives of the Press occupied the same tables as at the Reform Committee examination. The public gallery was deserted, only one or two of the many headed looking in for a few minutes at a time; but the entertainment not being very lively to an outsider, they soon left to return no more.

"There must have been a ton or two of books, documents, charts, &c., brought into Court, the tables, even portions of the floor being filled with them.

"Mr. Advocate Wessels, with Advocate Bauer, Dickson and Duxberry, assisted by the Hon. Mr. Molloy, M.P. (English Bar), and the Hon. R. Solomon, Q.C. (Cape Bar), instructed by Messrs Solomon and Thomson (Johannesburg), and H. L. Scholtz (Pretoria) appeared for Mr. Hay.

"Mr. Advocate Esselen, with Advocates Curlewis and C. Jeppe, assisted by Mr. Gordon (English Bar) and Mr. Foster (Cape Bar), instructed by Messrs. Dumat and Wentzel (Johannesburg), and Rooth and Wessels (Pretoria) appeared for the Gold Recovery Company.

"The pleading set forth: First, in connection with Patent No. 47, (1) that on September 28th, 1888, Patent No. 47 was issued to Messrs. John Stewart MacArthur, Robert Wardrop Forrest, and William Forrest, and confirmed on November 28th, 1888. 2. That the final specification is set forth in Patent No. 47, attached to the summons. 3. That the speculation mentioned sets forth an alleged invention to extract gold and silver from their ores. 4. That the patent was ceded on December 4th, 1891, to the defendant company, which alleges it possesses exclusive right to use cyanide and cyanide combination as a method of extraction for gold and silver, and to exclusively make use of this alleged invention in the South African Republic. 5. That the defendant company had no right to arrogate to themselves exclusively the above-named rights, as the said Patent 47 was obtained unlawfully, and encroaches on the right of the plaintiff as one of the public. 6. That the specific grounds on which the plaintiff relies for the cancellation of the said patent are as follows:—(*a*) That the persons representing themselves as the first discoverers are not the first true discoverers. (*b*) That the alleged invention is not new, or was not new at the time of the issue of the said patent. (*c*) That the patent is not one such as can be patented in the terms of Art. 1 of the Patent Law. (*d*) That the description is not complete, inasmuch as the persons demanding the patent contend that the solution must be a weak solution of cyanogen, while, as a matter of fact, the given solution is not a weak solution of cyanogen. That the patentees rest their invention on the fact that the so-called cyanogen solution converts gold and other precious metals into a solution, whereas the base metals are not affected by the medium of solution; but that this is incorrect, and that the said solution does not possess the advantages alleged in the specifications. That the matter of making the solution described in the specification is incomplete, and is not definitive, but experimental, and that it is vague, as it does not represent any definite rule, and no proper explanation of the proportions of the quantity of cyanogen to the precious metal. 7. That the plaintiff will make use of the patents, books, papers, pamphlets, &c., therein set forth, which included the specifications of the patents issued to J. H. Rae, in America, in 1867 and 1887, to collect gold from sweepings, and an apparatus to treat 'floured' quicksilver, and one issued in the same country in 1885 to Jerome W. Simpson 'for improvements in the process of extracting gold, silver and copper out of their respective ores.'

"The plaintiff says further that the alleged discovery was in use in this State before it was patented by the said MacArthur, Forrest and Forrest, and by one Henry Forbes Julian, on the following properties among others—on the Witwatersrand Goldfields:—The Pioneer Gold Mining Company, Limited, towards the end of 1887, and at the

Roodepoort United Main Reef Gold Mining Company in the earlier portion of 1888.

"Wherefore the Court is asked to declare that the said patent was obtained illegally and unlawfully, and that it be cancelled.

"Secondly, with regard to patent No. 74.

"Articles 1, 2, 3 and 4, are the same as with regard to patent No. 47, except that 74 is substituted for 47. 5. That the defendants have no right to arrogate to themselves the exclusive rights on the said alleged invention to use it in this country, as the said patent has been obtained illegally, and encroaches on the rights of the plaintiff as one of the public. 6. That the specific grounds for the cancellation of the patent are:—

"(*a*) That the persons alleged to be the first and true inventors are not the first and true inventors; (*b*) that the alleged invention is not new, or was not new when patented; (*c*) that the patent is not such as could be patented in terms of Art. 1; (*d*) that the description given is not complete, for the same reasons as was alleged with regard to patent No. 47.

The Reply.

"The defendant company replied, after making several exceptions, which resulted in the summons being amended, that they acknowledged pars. 1, 2, 3, and 4 of the summons, but they denied the allegations contained in pars. 5, 6, and 7, save and except that, for many years before the date of the said patent, a solution of cyanide of potassium and water was used as a medium of solution of gold and silver in the process of electro-silvering, and that nothing contained in par. 7 of the summons contains grounds for cancellation of the patent. And they pleaded specially with regard to that portion of par. 7 in both the first and second patents, in which reference is made to the patent granted on May 12th, 1888, to Werner Siemens, that the patent in question encroached on the rights of the true and first inventors of the invention patented as stated in the summons, and that such patent was subsequently cancelled in accordance with Art. 30, Law 6, 1887, in the case of MacArthur, Forrest & Forrest *v.* Werner Siemens, by an order of the High Court.

"Advocate Wessels then addressed the Court. He read the summons, which set out in full the cause of action. Then he read the specification of the patent. He drew attention particularly to that portion of the third par., where it says:—'In practice we find the best results are obtained from a weak solution, or a solution containing an extremely small quantity of cyanogen or a cyanide, such weak solution having a selective action, such as to dissolve gold and silver in preference to baser metals.' Then he referred to the part of the patent which spoke of the way gold was recovered: 'When all, or nearly all, the gold is dissolved, the solution is drawn off from the ore undissolved residue, and is treated in any known way, as, for example, with zinc for recovering the gold and silver.' He said that the recovery by precipitating the gold on zinc is spoken of here as a known way, yet, in the patent No. 74, they sought to patent this. He contended that that part of the specification, 'In dealing with ores and compounds, or compounds containing, per ton, 20 ounces or less of gold or silver, or gold and silver, we generally use a quantity of cyanide, the cyanogen of which is equal in weight to from one to four parts in every thousand parts of the ore or compound, and we dissolve the cyanide in a quantity of water of about half the weight of the ore. In case of richer ores or compounds, whilst increasing the quantity of cyanide to suit the greater quantity of gold or silver, we also increase the quantity of water so as to keep the solution weak,' and later, 'in some circumstances it may be found desirable to conduct the operation under pressure in a closed vessel, and a higher than ordinary temperature may be used if desirable;' all this, he contended, went to prove that the patent was for an experimental process, which was not a process which could be patented. He contended, further, that cyan-kalium, or potassic cyanide, was not invented by the MacArthur-Forrest process, but was known long before, as a solution in which gold or silver would dissolve. It was not capable of a selective action, as he was prepared to prove that its action on gold mingled with different compounds varied greatly. He also contended that it was a well-known metallurgical compound used to dissolve gold from its ores.

"Advocate Esselen said that the issue of the action would depend greatly on the fact whether they had discovered the 'selective action' of cyanogen. They had discovered that a weak solution of cyanogen produced a better result in treating gold than other ores. He said that the only use made of cyan-kalium prior to the use made of it by this patent was in connection with silver-electro. This process of dissolving gold or silver by means of cyan-kalium altogether differed from this process. The learned counsel then went through the different processes in vogue prior to the MacArthur-Forrest process for extracting gold from its ores. He referred to the chlorination process, and then to that of quicksilver, in both of which he contended that the processes had failed to obtain the finer portions of the gold, particularly in the cases of refractory ores. In referring to the method of treating gold over plates with quicksilver, he said that in some ores while they passed over the plates, a thin layer of something appeared on the plates, which prevented the gold being taken up at all. This was known as 'sickening' or 'flowing quicksilver.' Cyan-kalium had been used to clean the quicksilver, but he contended that cyan-kalium had never been used as a solution in which to dissolve gold or silver. Speaking of the utility of the process, he believed his learned friend was agreed as to the utility of the process.

"Advocate Wessels: With regard to the utility of the process, the MacArthur-Forrest process is not used on the Rand at all. This I shall be prepared to show, and also that cyan-kalium was known and used before that patent as a medium of solution for gold.

"Advocate Wessels, in reply, said that he would analyse the specifications, then he would prove the state of knowledge that existed prior to 1888, when the patent was taken out. He would show that in the early part of that year it was well known that cyan-kalium could be used as a medium of solution for gold. He would show that gold which exists in ores, and that gold mingled with different compounds, is soluble in cyan-kalium. It was known in 1887, and even before that gold was soluble out of ores by cyan-kalium. Rae had a process in which his medium for precipitating the gold was by electricity. He would quote the Simpson patent, by which 1 lb. of cyan-kalium was used in combination with 1 oz. of carbonate of ammonia. In this Simpson was well aware that the main re-agent was cyan-kalium. He would show that the same question was brought before the German judges, and they decided against the MacArthur-Forrest patent; and that they held that the Simpson patent was but an anticipation of the MacArthur-Forrest process. The small addition of the carbonate of ammonia did not affect the process at all.

"Mr. Wessels, continuing, said he should endeavour to show by authorities that this process did not involve any inventive skill, and was not a patent in England when tried before judges. He would be prepared to prove that the mere fact that a weak solution was better than a strong one as a medium of solution for gold was no evidence of inventive skill. He would show that, to speak of the proportion of cyanogen to gold was absurd, and that the selective action was not selective at all and not patentable. He would be able to prove with experiments on a large scale, no mere laboratory experiments, with both the MacArthur-Forrest process and Simpson's process, that, in treating large quantities of gold, Simpson's process was the better process and produced purer results. He would show that selectiveness existed as much in Simpson's and in Rae's processes as in that of the defendant company. Then the question would arise whether the addition of carbonate of ammonia gave the defendant company the right to contend that Simpson's process was not an anticipation of theirs. He would show that, while it was well known that carbonate of ammonia was not a medium for the solution of gold, it was well known that the cyanide of potassium was. He would further contend that, if cyanogen was known as a medium of solution for gold, the fact that they did not state this in the specifications of their patent, and their process was only an improvement, was sufficient to damn their patent. He would show that MacArthur and the Forrests must have known of the previous patent. The success which attended the better advertising and the extended use of the process was not in itself a fact which made it patentable. Further, he would prove that zinc was used, as they described it in Patent No, 74, to precipitate gold from other solutions, and the fact that this was not set forth in the specification of that patent, and that this was merely an improvement, would settle that patent; and further, that Patent No. 47 was itself an anticipation of Patent No. 74.

"Second Day.

"Prof. Hahn's Evidence.

"The important discovery was the 'selective action' of the thin dilute solution of gold. The 'selective action' I should term the preferential action of one body on another in the presence of two or more other bodies, the first having an action on the second without affecting the other two. I should term this a useful discovery. The principal point in Rae's specification is the current of electricity which was used in the extraction of gold. The use of chemicals is but a subsidiary point, as the patent suggests use of suitable solvents such as cyanide of potassium, but does not even give strength to the solution used. Rae's patent spoke of the combined action of the current of electricity and suitable solvents. In answer to Judge Jorissen, the witness explained the action of electricity on a solvent such as cyanide of potassium and gold and another metal."

Is it not remarkable that in the Transvaal, as well as in England, the plaintiffs mentioned two Rae patents, and seem to have forgotten that Rae, in 1866, had obtained a patent for extracting gold—not from sweepings, but from ores?

"Witness (continuing): I have read the specification of Simpson's patent. This cannot be said to be anticipatory of the MacArthur-Forrest process, for, in the Simpson's patent, the solution is made up of three different groups of chemicals, cyanide of potassium, carbonate of ammonia, and chloride of sodium. Simpson regarded the carbonate of ammonia as a precipitant of gold. If Simpson was of opinion that cyanide of potassium was a sufficient solvent for gold, he would not have added a carbonate. In Simpson's patent the strength of the cyanogen was 3 per cent., while in the MacArthur-Forrest process it runs from ·5 to 2 per cent. With regard to Dixon's paper, nothing therein contained can be said to anticipate the MacArthur-Forrest process. In that, the principal agent is potassic-ferro-cyanide. According to this process, the base metals are taken out and the gold remains behind, while in the MacArthur-Forrest process the gold is taken out and the base metal left behind. Skey's paper cannot be said to be anticipatory of the MacArthur-Forrest. In this paper he speaks of using potassic cyanide for the purpose of keeping the surface of the mercury clean. He has observed that some of the gold may be saved, but nowhere in his paper does he speak of the use of potassic cyanide for the purpose of extracting gold from its ores. He ascribes the presence of this gold solution to the action of electricity which is produced when gold and mercury meet, when in the presence of a potassic cyanide solution. I made experiments to ascertain whether the selective action existed. I made those experiments very recently, late in December and in January. I made them to satisfy myself whether the selective action existed or not. The result of all three experiments showed that the selective action, which is the basis of the MacArthur-Forrest process, existed.

"By Advocate Wessels: I knew that potassic cyanide dissolved gold, fine gold, and leaf gold, but I was unaware before I made any experiments that it would dissolve gold from its ore. The potassic cyanide has the same action on silver as on gold. If two pieces of

metal, one of gold and one of silver, were put in the solution, they would both be dissolved. If, however, an amalgam of gold and silver were put in the solution, it would not of itself dissolve unless it were stirred. Raymond, in his conclusions, was absolutely wrong. I knew that it was known prior to 1887 that gold was soluble in cyanide of potassium. I knew personally that gold was soluble in that compound, and it was in view of that knowledge that I first made the experiments to see if it would dissolve the gold from its ore. Mellin laid down the principle that gold was soluble in cyanide of potassium. This was in 1852."

It is not Mellin, but Melin, who mentioned the solubility of gold in cyanide solution, and he was simply repeating the statement made several years before by Dr. Elsner, in his famous paper on the behaviour of gold and other metals in a cyanide solution.

"The fact that gold and silver were soluble in potassic cyanide was made use of in electro-plating. A person acquainted with chemistry in all its branches, and having read all the books on the metallurgy of gold, would be drawn to the conclusion that if gold in its ordinary form was soluble in cyanide of potassium, that gold in its ores would also be soluble in cyanide of potassium. From the evidence of Frederick Douglas Brown, professor of chemistry in the Auckland College, Australia, it appeared that gold, and gold in its ores, was soluble in cyanide of potassium. If I treated tailings in which there was no gold, but only base metals, with any reagent I could find, the stronger the solution the more base metal I should get. In ores in which gold existed in combination with other metals, the stronger the solution the less gold I should obtain. The result found by other experts that, in the stronger solution, the same amount of gold was extracted, but with the disadvantage that more base metal compounds were formed than in the dilute solution, is in conflict with the experiments made by me. I should be surprised to hear that gold obtained from the North Clewer Estate, where the gold is largely mingled with copper, that while in a solution of 10 per cent. strength, 62 per cent. of gold is obtained, in a solution of only 1 per cent, strength, but 13 per cent. of gold is obtained. Nothing was known in chemistry, to the best of my knowledge, of the selective action of a dilute solution of cyanide of potassium on gold in the presence of base metals. I admit that in case I found in an experiment that a strong solution wasted too much, that I should try a dilute solution. I do not, however, go the length of your proposition, that a person experimenting on a large scale would keep on diminishing and diminishing the strength of the solution till he ascertained the strength with which there would be the least loss."

Nothing of importance occurred on the third day of the trial.

Fourth Day.

"In the course of the re-examining of witness who has been in the box three days, on ferro-cyanide, Mr. Wessels said, if the question were allowed, he would have to cross-examine the witness again on the point.

"The Chief Justice: How long are you going to keep this witness in the box? It is not fair to tax the patience of the Court in this way.

"Mr. Wessels: In a case in England, a case of much lesser importance than this one, one witness was in the box for ten days and another for seven days. We are only putting questions of the greatest importance, and the case, you will admit, is one of the greatest importance.

"Mr. Justice Jorissen said: I agree with the Chief Justice. You have placed six large volumes of evidence taken on commission, and you expect us to peruse it. Now you have this witness in the box, and are asking him the identical questions.

"Mr. Wessels: We must have this witness to make an impression on the Court one way or another.

"In reply to the Chief Justice,

"The witness said he adhered to his opinion that in the Simpson's process electricity was the chief agent."

We call the attention of our readers to this declaration, the most strange and remarkable, because in the Simpson process and patent no mention and no use is made of electricity.

"William Arthur Caldecott, an analytical chemist residing at Johannesburg, said he was a B.A. of the Cape University, and studied under Professor Hahn.

"Mr. Wessels: I am also a B.A. of science and mathematics, but that does not prove anything.

"Witness, proceeding, said he was acquainted with the MacArthur process, and had managed cyanide plants from the beginning of the process. He conducted the tests at the Salisbury Mine for the Cassel Company. The experiments were very successful. After that he went to Barberton to treat the Sheba tailings. Since then he had managed cyanide plants for the Moodies, the Barretts, and the African Gold Recovery Company, all of whom used the MacArthur-Forrest process. At the beginning the strength of the tests were 1 per cent. and 1·2 per cent. They were satisfactory. They now used ·25 per cent. and ·3 per cent. The strength had been gradually reduced. He made experiments in October last with tailings in the Natal Spruit, where he put up five vats. He kept particulars of the strength of the solution and the amount of tailings used. He had five vats, and in each he put 34·3 tons of tailings, and to each vat he added about half its weight in solution, and each vat contained a solution of different strength. Each vat was separate from the other, so that they could not become mixed. The strength of the five solutions were as follows:—·052 per cent., ·140 per cent., ·475 per cent., ·320 per cent., and 4·334 per cent. Each solution was three times as strong as the one preceding it. Samples were taken before the treatment of the tailings and the composition ascertained. The strength of the solution was also tested.

"The Chief Justice: And what was the result of the experiment?

"Witness: As far as the gold was concerned they were practically the same. There was only a difference of about two grains in the residue.

"How long did these experiments last?

"Witness: The tailings were in the solution altogether three days 19 hours.

"The Chief Justice: And your experience is that a solution ·052 would give the same result as 4·334 per cent.?

"Witness: Yes, as far as the gold was concerned.

"And was there any difference in the base metals?

"Yes. As far as the base metals were concerned there was a gradual rise corresponding with the strength of the solution.

"Each vat was treated at the same time. His results were not the same as those on which Professor Hahn was examined. He should think those were different ores, as they behaved differently to the ores he treated. His experiments were typical of the Rand tailings. The experiments by Professor Hahn were from quartz. His experiments would be accepted as showing the results obtained from Rand tailings. His experiments went to show there was selective action. He knew nothing of the other experiments. In fresh ore there was more gold exposed to the action of the solution. Ore was treated by this process in certain places. As a rule at the Rand only tailings were treated.

Prof. W. Crookes's Evidence.

"Prof. William Crookes, Past President of the Chemical Society, and Past President of the Institute of Electrical Engineers, said: I was examined in London.

"Adv. Wessels: I may take it from the evidence given by you in London that you did not know that potassic cyanide was used as a solvent to extract gold from its ores?

"Prof. Crookes: Prior to 1887 I was not aware of this.

"Adv. Wessels: You were the editor of the *Chemical News*.

"Prof. Crookes: Yes.

"Adv. Wessels then read a letter which appeared in the *Chemical News* in 1866 from Hy. Woods to Prof. Surinam, in which the latter spoke of a process of extracting gold from its ores by means of a sodium. This, Prof. Crookes said, was the description of a sodium amalgam."

The letter in the *Chemical News* was a reprint from the *American Journal of Science*. The passage of the letter referred to was not from H. Woods to Prof. Surinam, but from Prof. Henry Würtz to Prof. Silliman, editor of the *American Journal of Science*. It was not a description of a sodium amalgam process, but an example of precipitation of gold from a solution of gold obtained by cyanide of potassium from the ores, especially when it was in a dilute solution. The extract of this letter was published for the first time by the Electrical Review two or three months ago.

"Fifth Day, Friday, February 21st.

"Adolph van Geunert, an analytical chemist, connected with the Rand Ore Reduction Company, said half a million tons of tailings were treated at their works in 1887. He knew that cyanide was a solvent of gold. In 1888 he made experiments under Dr. Siemens at Berlin, in the matter of extracting gold from the ore by means of cyanide. The results were so satisfactory, that the same year he was sent to Siberia to see if the process was suitable for treating the ores there. At that time he had never heard of the MacArthur-Forrest process. In treating the Main Reef series the strength of the solution made little difference. As regards the extraction of gold with zinc precipitations, the strength of the solution was mostly ·95, while with the electrical, or Siemens process of precipitation, the highest strength of the solution was ·1; but in some cases in which the gold was very fine, they used a solution of ·02.

"Witness, proceeding, said in the wet processes they would rarely use more than 1 per cent., and 5 per cent. would be the highest they could use on account of the poisonous properties of cyanide. He had noted the experiments of Dr. Hahn. He had treated large quantities of tailings, and found that if the extraction was not good he would raise the strength of the solution. He would start with a solution of ·08, and if this solution did not take out all the gold, he would increase it up to ·15. This was the strongest he had ever used, and in Dr. Hahn's experiments the weakest solution was ·5 per cent.

"Asked as to his opinion as to selective action in the MacArthur process, witness said he generally found that he got very much the same results from a weak as a strong solution, although it sometimes happened otherwise.

"By the Chief Justice: In treating Main Reef ore I use two processes. The MacArthur-Forrest process, where the precipitation is done by means of zinc; the Siemens process, where the precipitation is by electricity. In the first I use a 0·2 per cent. solution. In the latter from 0·1 per cent. to 0·2 per cent. With other quartz outside the Main Reef I find it impossible to lay down a hard rule. With a stronger solution I often get a higher percentage of gold as well as base metal. I have never experimented in this country with solutions of a greater strength than 1 per cent."

(To be concluded.)

ELECTRICAL DRIVING OF MACHINERY.

In a recent paper read by Mr. Daniel Adamson before the Manchester Association of Engineers, the author reviewed, at some length, what has been done abroad, and then went on to say that we, in England, are as yet only at the beginning of electric driving, the chief installation visited by him being that of Messrs. Siemens Bros., of Woolwich, who have now going generators coupled to high speed engines aggregating 1,200 H.P., and saving 3,000 tons of coal annually, and considerable wages. At Middlesbro' there are two works closely

contiguous that are using electric driving, one a wire works, the other a rolling mill, with its various tools. At Messrs. Adamson's own works at Hyde, the idea of electric driving came to them in connection with some new cranes. They therefore put down an engine and dynamo to do this, and also left a margin for lighting also. These first cranes were so satisfactory, that it was decided to add to their number and enlarge their original ideas, and they now have in hand a 75 kw. dynamo for direct coupling to 100 H.P. Belliss engine at 400 revolutions. Their first trial was of a small motor to drive the Green's economiser, previously driven by a long cotton cord stretched across an open yard, and liable to great variation from weather. To drive their boiler shell drill they obtained a motor from America, being unable to buy one here *at a reasonable price*. This has worked since September. This motor had to be arranged to suit the peculiar movements of the drills, so as to run in either direction, and to have in one direction two speeds, and all these to be controlled by one handle, so as to be similar to the previous belt shifting handle, which it replaced. The motor thus enabled them to cut out several pulleys with their belts.

The most important application as being perhaps most novel was to the hoists in the riveting tower, which enabled the stoppage of some 50 feet of shafting with six belts, and gave also to the men a more easily controlled apparatus. Curiously enough, prior to the complete driving of these hoists by motors, they were first driven by a motor which replaced some belts and countershafting, and it was found that the belts up in the tower then lasted longer than they did when the countershafts were steam-power driven. He does not attempt to explain this, but it may possibly be due to the less positive pull on the belts, when electrically driven, than when driven by a powerful steam engine with a disposition in its fly-wheel to maintain uniform speed at all times, whereas an electric motor, when not too powerful, probably eases up for a short time when heavy loads are put upon it. There will be less straining effect with a gently-starting motor.

Some figures are given of the electrically-driven shop-travellers, three in number, and we reproduce this table, as it is valuable :—

Lifting capacity	30 tons	10 tons	5 tons
Span	45 feet	45 feet	45 feet
Weight	24 tons	14 tons	6½ tons
Hoisting speed—light	5·7 feet	17·4 feet	30 feet
„ „ full load ...	2·4 feet	7·3 feet	13·1 feet
Power—light	3·7 H.P.	3·6 H.P.	3·7 H.P.
„ full load...	9·0 H.P.	9·6 H.P.	10·4 H.P.
Travelling speed—light	68 feet	88·4 feet	144·8 feet
„ „ full load ..	41 feet	67·4 feet	132·2 feet
„ power—light	3·3 H.P.	2·6 H.P.	2·5 H.P.
„ „ full load ...	5·0 H.P.	3·3 H.P.	2·8 H.P.
Traverse speed—light	38 feet	68·6 feet	66·8 feet
„ „ full load ...	20 feet	40·6 feet	59·3 feet
„ power—light	1·5 H.P.	0·7 H.P.	0·48 H.P.
„ „ full load ...	3·1 H.P.	1·35 H.P.	0·85 H.P.
Hoisting efficiency at full load ...	54·3%	51·3%	46·9%

He quotes from a paper by Mr. Barr, to the effect that to drive a flying rope called for 5·9 to 6·3 I.H.P. per 100 feet length of shop, the ropes running at 2,200 and 1,570 feet per minute. This agreed with his own experience. Hence, to the tabular powers above, about 8 to 10 H.P. would be added for their own shop of 200 feet, and when the crane is not in use, a constant 11 H.P. would be absorbed, as against the small proportion of the friction of the engine and dynamo.

The frictional losses of mechanical transmission are, he says, 15 to 20 per cent. This is a moderate estimate in our opinion, but it is as great as the loss of current in electrical transmission. In the first case, however, frictional loss implies wear of ropes, and of brasses and shaft necks, and so on, whereas electrical loss does no harm if not excessive, and such as to imply over-heating. From one-seventh of the total power to about four-fifths is the ratio of the power to turn shafting in different American works, according to an American authority, Mr. J. Flather. In their own case shafting absorbed quite 60 per cent., apart from the further loss in the crane ropes.

He sums up his eulogium of electrical driving by referring to the great elasticity which it confers on shop arrangements, more especially in respect of extensions or alterations, the original design for workshop being much simplified, and here the future extensions can be made in any direction, and not be controlled by exigencies of millwright's work.

PROCEEDINGS OF SOCIETIES.

The Northern Society of Electrical Engineers.

Discussion on Messrs. Cowan & Still's Paper—The Regulation of Pressure and the Reduction of Light Load Losses in Alternating Current Systems of Electric Supply.

Mr. Rider said he should first of all say that he had listened to that paper, and read it, with deep interest, and that it was one of the most interesting papers they had ever had before them. He said that without any disparagement to any they had had. So far as the first part of the paper was concerned, in dealing with the regulation of pressure, he was fully in accord with the authors. In the "Thomson" diagram the size of the feeder which worked out most suitable for that particular current came up to 19/14. Taking the maximum current at 71 amperes, which was given in the paper, that came to about a density of 750 amperes per square inch, which was a very safe working current for a feeder. He fully agreed with the statement that the size of the feeder should be determined by the current it had to carry, and that the drop should not be taken into account at all, as by the Thomson law, the loss per mile due to the drop increased in the same ratio as the cost of the feeder. With regard to the regulation of the feeders, the method the authors had drawn their attention to was one which he, Mr. Rider, was at present using, and he could speak of it in the highest degree. He would like to point out that it was only applicable, and could only be used, to keep the pressure at the feeding points absolutely constant when the different feeders and networks were distinct from each other. If they had one network and two feeders feeding at different points, they could not keep the pressure exact at those two feeding points under such conditions. They would have to cut the network; each feeder would have to serve its own network, and not be connected with any other. They then came to the second part of the paper. He was afraid that there was a good deal of debatable matter in it. A scheme which he, Mr. Rider, was putting down had been mentioned, that of using accumulators in connection with a motor alternator. He was not at present able to give any figures, because they had not started; but the Society must get his successor to give them a paper, and he would no doubt tell them more truth about it than he, Mr. Rider, would. The various points brought before them wanted very careful thinking about. It was recommended that for a light day load plant a separate steam pipe should be used. He presumed that it was meant that the main steam range should be cut off during the day. If they turned the steam on suddenly to a large steam ring, they ran the risk of breaking the joints. He believed in having steam on right up to the stop valves of the engines the whole of the time, otherwise they might have a big smash. The scheme which was brought before them for reducing light load losses was no doubt very interesting, and the figures which were given were also very plausible, but he could not altogether see through them. The authors mentioned that they found a saving of 17 per cent. in the horse-power when running through this augmentator, having the engine speed reduced two-thirds, that was 17 per cent. of saving; it was not 17 per cent. of the full horse-power of the engine. Supposing the engine was 100 horse-power, it was a very bad plant if it took 20 horse-power to drive it at no load. If they took 17 per cent. of the 20 horse-power, it only brought them to about 3·4 horse-power, which was not a very great saving. He thought the best way would be to put in a much more efficient plant, say an open coil alternator with no iron in the armature, rather than using one with heavy losses. Surely, if an alternator with no iron in the armature was awkward to run in parallel with the iron-cored machine which they had at heavy load, the difficulty would only come in at the time of paralleling to change over, as the small plant would then be stopped. It was suggested that the governors of the engines should be arranged so that they would give the variation of speed mentioned. He wished to see the governor which would enable them to alter the ratio one-third, and still have a good range of governing. He thought if they had governors which would give an adjustable range of 5 per cent. they were good governors. This method of reducing losses only took into account the losses at the station, and did not affect the losses outside; in fact, they were going to increase the losses outside, and when their station became a large one, and the number of transformers very large, that method would be in a still worse place, because heavy losses would be going on all the time outside. With regard to the question of altering the frequency of arc lamps and meters. Last year at Bolton they reduced the speed of the whole of the plant 17 per cent., not on account of the alternators, but for reasons which were purely mechanical. They brought the periods down from 100 per second to 83 per second. They had a number of arc lamps in the town, and they had not to alter the regulation of a single one; in fact, they burnt better. With regard to the meters, some of the meters were made for 100 periods, and he thought that some of them would be reading a bit out at the reduced periods. He made careful tests, and put in series with these meters other meters specially made, and he found practically no difference at the end of the quarter, taking the ordinary working load of the meters. They were Chamberlain & Hookham and Shallenberger meters. The paper said that as there were no alternating current motors in use, they need not be taken into consideration. He, Mr. Rider, said alternating motors were in use in many stations, and if a station had only one motor in use, the result of such a procedure as lowering the speed of the plant every day would be to damn the system.

Mr. Mordey said: Before speaking on the paper, he wished to be allowed to say a word of explanation. In the report of their last meeting, he read that the president had done him the honour to regret his absence, and that the author of the paper, Mr. Hammond, did him similar honour. The fault was scarcely his. He was not a member of the Institution; he had had no notice of the meeting nor copy of the paper, either from the Society or from the author, nor had he been invited, so that he could hardly have been expected to be present. With regard to the matter before them, he wished to join in congratulating the authors on the paper, which was an excellent one; he wished they had more such papers in London. They did not get as many of them as they ought. A great many points were touched on, but he must confine himself to a few of them only. With regard to the first paragraph, he quite agreed with the plan the authors advocated, and which was shown in fig. 4*; it was a very good one, and one which, in many cases, had advantages. The Brush Company used it a great deal; he thought it was Mr. Dawbarn of his company who first introduced it, and they found it convenient and simple. Ideas as to "banking" transformers had changed, they did not get very much advantage if they used transformers above a certain size. In a 12 or 15 kilowatt transformer they got a no load loss of between ·75 and 1 per cent., and no matter how large the transformer might be, the loss did not go much below that, so that

* Electrical Review, March 27th.

there was no advantage in efficiency in having very large ones. And as to cost, the lower price per kilowatt of larger transformer had to be set against some extra cost in mains and inconvenience in handling. It might be hypercritical, but he wished to object to the capacity current being spoken of as being in advance of the E.M.F. He knew it was the universal way, but it was wrong, it gave a wrong impression. The ordinary, or, he might say, the general explanation given of the difference between self-induction and capacity was, that self-induction caused the current to lag behind the E.M.F., while capacity caused it to lead, or be in advance of the E.M.F. He once heard an eminent professor explain that self-induction was something that when the E.M.F. was applied delayed the flow of current, while capacity was something which sucked the current out before the E.M.F. was applied. This amounted to saying that the effect preceded the cause. In the interests of clearness of perception of the physics of the matter he wished to protest against this way of speaking of the effect of capacity. What really happens is, that the current is caused to lag still more by capacity than by self-induction; the capacity current lags so much behind the wave of the E.M.F. producing it, that it is just in front of the succeeding E.M.F. wave. For mathematical purposes, it may be convenient to consider it as in advance of the E M.F., but it must be remembered that this does not correctly represent the fact. Instead of saying it was a quarter period in advance of the E.M.F., it would be physically more correct to say that it was three-quarters of a period behind the E.M.F. The authors alluded to an excellent method of regulating shown in the various diagrams 3* and 4.* He thought that the arrangement of the Manchester Company, or of Mr. Rider, was an excellent one; it did not differ in principle from what had been seen before, but he thought it was the most practical way of applying the principle. With regard to the saving of power when the pressure was raised by apparatus of that sort, he might mention a fact from his own experience. In one station with which he was acquainted it was necessary to raise the volts. He found on going into the question as to whether there would be a loss of power, that there was a saving of power. He found that by raising the volts by an augmentator, the actual power absorbed by the alternator and the augmentator was less than by the alternator alone, if worked up to the full E.M.F. He mentioned that as illustrating the effect of the apparatus which was called a "hitcher-up." There was another point in connection with "hitching-up" which was perhaps of some interest. There had been a good deal of discussion as to whether they ought to have self-induction or not in alternators. He had always thought the less they had of it the better. If for no other reason, for the very sufficient one that it spoiled the "characteristic" of a machine, and made regulation troublesome and difficult. When it was working normally there was no need for self-induction, but there were, perhaps, certain abnormal conditions under which self-induction might be of service, if the required effect could not otherwise be obtained. For example: They had two alternators without self-induction, and put them in parallel when they were out of phase, causing a more or less violent shock under current. If they had attempted to lessen the shock by giving the machines a good amount of self-induction, they would lessen the shock but the machines would regulate badly; they would have a large drop in the E.M.F. when the load was increased. With an augmentator, however, with the fine wires across the mains and the thick wire in series with the alternator, they had self-induction, but it was only self-induction when the machines were out of step. At other times it had no effect on the regulating qualities of the machine. This was a valuable feature, in his opinion, in connection with the use of augmented alternators. An important matter was raised by the proposals to reduce the losses in alternators at light load. He rather agreed with Mr. Rider's criticisms on the proposals. He thought the whole point of the diagram No. 7* was that the machine was an unfortunate one for the purpose. He did not mean to say that it did not illustrate the proposal well, but he was quite sure that the authors would not put it forward as a machine that had other good qualities than that of showing the need for reducing its load losses. He was rather in favour of reducing the engine losses at light load than reducing the alternator losses. Of course, engines should not be run with very small loads, but in cases where it was necessary he thought that the losses of even a large alternator were so small that the probability of using a small engine should be considered in connection with some clutching device, by which the alternator would be driven in the day time by a small engine, and at night by the large one. He might illustrate what he said about the careful lagging of the cylinders by referring to a recent experience he met when he was carrying out a test. As the people who built the engines were very anxious to get good results, they had every door and window closed. He was assured by the man in charge of the engine that if they had the doors and windows open, there would be a very perceptible increase in the amount of fuel consumed. He suggested that they might put the engine into the feed water tank, so that the lost heat might be recovered. Upon the subject of alternators, he should like, if there had been time, to say a good deal. He thought it was a mistake to suppose that in a machine without iron in the armature they got such a very large current on short circuit. As a matter of fact, the current on short circuit, with an armature without iron in it, was not—and need not be—more than with machines with iron cores. In his own machines they always short circuited the terminals with full steam on, and the current usually did not rise above three times, and he had never yet seen it more than five times the full working current. They had learned by experience that they must make machines to stand short circuiting, and had had no difficulty in doing so without losing the good regulating quality which he thought, next to safety, was of prime importance to central station engineers. The first thing to have, after safety, was a machine with the smallest possible fall of potential and self-induction. Just one word, before he concluded, on the subject of reducing speed. If the authors would consider that the light load dynamo under most circumstances was running a large number of transformers, and was fairly heavily loaded, even with no lamps on, he thought that they would see that a reduction in the speed was not advisable, because the total transformer loss would increase more rapidly than the alternator loss would diminish. This would be the case at least in stations where the day load dynamo and engine were fairly proportioned to their load.

Mr. Statter said that he had very little to say, except that he must congratulate the authors of the paper. With regard to diagram No. 2,* he would like the authors to tell him why they limit the money to be spent on the feeder to the copper. It seemed to him that they ought to be able to spend as much per annum on the losses in their feeder as they incurred by way of interest on the total sum expended in materials, and in the labour for laying the same, plus an allowance for depreciation in getting the current from point to point. He supposed that in central station work it was a very difficult matter to fix upon the size of conductor, because they did not know what the requirements in the future would be. But if Thomson's law was used at all, then 10 per cent. (the authors' figures for interest and depreciation) of the total cost of the feeder, and of laying it, should be plotted, instead of 10 per cent. of the cost of the copper and insulation only, as plotted by the authors. In 1882 or 1883, Mr. J. E. H. Gordon was carrying out an installation at Paddington, for which Messrs. Crompton supplied certain apparatus, and he (Mr. Statter) was then a pupil with that firm, and it was he who informed the authors of the use of the term "hitcher-up." He was not quite sure who did the christening, whether it was Mr. Gordon or Mr. Kapp, but it was one of the two. He thought that the idea of augmentation was transmitted to Mr. Kapp, and was really due to the late Mr. J. E. H. Gordon alone.

Mr. Wordingham said: He did not wish to take up much time, as he was afraid the authors of the paper were getting tired of being congratulated, but if they would allow him he would like to say that it was certainly one of the best papers they had had. Its terseness, clearness, and practical nature, were very striking. The first point he wished to refer to was with regard to the fourth method of distribution described in the paper. He thought the authors were certainly right in saying that it was the most convenient and best way of distributing; at the same time, in case of a short on the mains all the fuses might go, and it would be a terrible nuisance to get them back quickly, and there would be a very serious interruption in the supply; whereas if they had the transformers in sub-stations, they could very rapidly get their fuses replaced. He thought the position the authors had taken up about the most economical size of feeder quite unassailable. The current density which had been worked out in that diagram was about what he believed to be the best density they could find; it was about 750 amperes per square inch, which agreed fairly well with his own practice; he generally used 600 amperes. With regard to the device for showing the potential at the end of a feeder, which the authors said was largely used in America, he believed that that was due to Dr. John Hopkinson; that method was introduced and patented by him many years ago. He thought that that might be of interest to mention, as they did not like to get their ideas from America. The same consideration that occurred to Mr. Rider about the steam pipe occurred to him also; he did not think it was really practicable to shut off the main steam range for any part of the day, unless they were sure to have ample time to have it on again. If they had a sudden demand, and the range was shut off, the result would be disastrous. He might say a word with regard to the reliability of ejector condensers. At the Manchester station they had them on all their engines, and they had never had the slightest trouble with them, and they had given excellent results.

Mr. Nisbett said it was getting very late, and he did not want to take up the time of the meeting, but he would like to protest against diagram No. 2,* which, in his opinion, was entirely misleading, owing to the fact that the cost of laying the mains, armouring, making good the pavement, &c., had not been included. It was obvious that because these were standing costs, whatever size of mains you lay, they should not be left out, for when the main is worn out the armouring is worn out, and the trench is also worn out, and, therefore, depreciation on these should be added to that on the cable. This allowance would make the economical current density very much higher than the authors supposed. Taking the same example as the authors had done, viz., an average current of 26 amperes, adding to the cost of the cable that of the armouring and trenching, the economical section of copper would be ·03 of an inch instead of ·1, so that at load times that cable would be working at a density of 2,500 amperes per square inch. The authors, on the other hand, had taken the cost of energy lost in the cables at 1½d. per unit, whereas they had taken the energy lost in driving the pumping and other plant at something like ¾d. per unit, because they said the standing costs were not in such case chargeable. Of course, the same reasoning applies equally to the losses in the mains, it being only the coal bill which is increased. If, now, they add to the interest and depreciation on the cost of the cable the amount due to the trenching, armouring, &c., and reduce the cost per B.T.U. lost in the mains to ¾d., instead of 1½d., it was at once obvious why Thomson's law was not more generally adopted, at any rate, for high tension mains; for the law showed that the economical section is such that if it were used the mains would be red hot at load time every evening. There were one or two points in connection with the system of distribution marked D. He could not altogether see that it had many advantages over the system C. Mr. Wordingham had raised a point about the difficulty of getting at fuses in transformer pits. That was a very important one. The contacts on transformers were very apt to get loose. He considered the scheme with sub-stations far preferable. All the contacts could be seen and examined periodically with ease, and the facilities for switching transformers in and out as the load varies were better; both systems, however, had their uses. Then

* Electrical Review, April 3rd.

the authors laid too much stress altogether on the amount of capacity current. They calmly talked about a capacity current of 10 amperes on a feeder. That would mean that the feeder would have to consist of 25 miles of 19/18 cable. He thought that they had put down to the cables that which belonged to the transformers. He agreed with the authors as to the necessity for regulation on feeders, and the apparatus designed by them seemed to answer its purpose admirably. With regard to the remark as to the cost of pressure wires, these are not so great as the authors seemed to think, as a pair of pressure wires can be put into a high pressure cable for about £35 per mile, which is not a very serious item. He did not agree with the authors as to the economy of injectors. He thought that they rather contradicted themselves, as he had read it. Apparently, they had overlooked the losses due to the condensation of steam and the necessary re-evaporation of the water; the pulsometer pump was an instance of that, and although a useful form, he did not think anyone would say it was a more economical form than a barrel pump. It seemed to him that a good pump of the ordinary type, driven by an electric motor, was far and away better than any injector.

Mr. Hesketh said he thought that the engineers at last saw the futility of seeking for an absolutely uniform day load, and the authors were now attacking the question at the right end, in seeking instead for high efficiencies at low load. Certainly any central station engineer, who settled down to solid work after hunting the phantom of a day load, would find that those little economies were very difficult to obtain, even more difficult, perhaps, than the day load. With regard to the question of boiler efficiencies, the efficiency of a boiler increases as the duty is lowered. He obtained about 9·5 lbs. of water per pound of coal when evaporating 9,000 lbs. of water, but reducing the evaporation to 6,000 of water, he got 10½ lbs. of water per pound of fuel, showing a great advantage from not pressing the boilers, or using rather large boilers for low duty. As to cutting off the steam range, he found that the losses in the steam ring were getting very considerable, and tried the natural expedient of cutting it off during light load time; but unfortunately the cost of repairing joints was double the cost of keeping steam up. There is also a great deal of loss in the use of feed water heaters. It is a very common practice to put a large feed water heater in the main exhaust pipe, and expect that they were going to get the full advantage of the whole of the heat units in the exhaust steam; that was a great fallacy. The same economy would be obtained by using the exhaust steam from their pumps to heat the feed water and condensing the main exhaust. If they so used the exhaust of their steam pumps, the losses in driving feed pumps by steam were not so great as they would at first appear. The steam taken by the centrifugal pump mentioned by the authors would not be 1 per cent. of the total steam taken by the engine, although its power might be 1 per cent., but the steam would be something between 5 and 10 per cent. The method of reducing engine losses by reducing the speed was rather drastic, and he would rather use an alternator without iron in the armature. They had one or two motors at Blackpool, and to alter the periodicity every day would cause such trouble, that they would have no peace at all. One of the greatest requirements in central station working was absolute confidence of the consumers in the supply, and if they were going to vary their speed every day, of course the consumers would never put up with it. As regards the low tension distribution in scheme D, he said that they had experimented with short circuits recently at Blackpool to see the effect, and found that the fuses acted immediately, and cut out the faulty section.

Mr. Lindley said that on the question of the reduction of the speed, he thought that apart from the difficulty which Mr. Rider had foreshadowed with the springs, there was the difficulty that they would have to stop the engine to alter them again before it could be put in parallel with the machines. He would like to suggest what might be done to meet that difficulty. It was not advisable to reduce the speed of the engine, providing you could put up with having the alternator running at full speed. The whole thing really centered on how much they could reduce the power of a compound engine without seriously falling off in the economy; this in a suitable engine should be one-fifth of full load, and then there would be no necessity to reduce the speed of one of the smaller units in order to operate the day load with economy. He might suggest to Mr. Mordey, who had been kind enough to offer to teach them something about putting engines into feed water tanks, that he, Mr. Mordey, might have put the steam pipes in also, so that they would get a higher efficiency still!

Mr. Still said, in reply, that Mr. Cowan and he had been prepared to meet with a good deal of opposition, as there was no doubt they had laid themselves open to attack from various quarters. The way in which the paper had been received was a very agreeable surprise, and he wished to thank those present, both on his own behalf and on Mr. Cowan's for the kind way in which they had spoken of it. He proposed to reply to the points raised on the first part of the paper, and Mr. Cowan would then deal with the second portion. He was glad to learn that Mr. Mordey had found the system of distribution, shown at D, in every way satisfactory; it certainly seemed to him very superior to the system of sub-stations with a heavy low pressure network, which neither from the point of view of economy or of regulation, made proper use of the many advantages of a high tension supply. With regard to Mr. Wordingham's remark that in the case of a short circuit all the fuses might blow, this was only applicable to the case in which all the secondaries of the transformers are connected in parallel, by closing the switches marked S, which would, most decidedly, be the wrong thing to do. In reply to Mr. Statter, and notwithstanding Mr. Nisbett's great confidence in his own assertions on the subject of Thomson's law, it is quite evident that in working out the most economical cross section for a feeder, the capital cost we have to consider is only that portion of the total capital outlay *which depends upon the amount of copper in the feeder.* Mr. Nisbett admitted that the laying of the mains, making good the pavement, &c., were standing costs, and did not depend upon the size of the cable, and this was the assumption which has been made in the paper; but Mr. Nisbett still thought that the amount of these costs should determine the size of the feeder. Why, then, should he stop at the culverts and trenches, and not include transformers and sub-stations, or even the cost of the generating station itself. The wearing out of the culverts or pipes, and the cost of keeping these in order, was a question of the choice of the system, not of the exact cross section of the cable to be used. If the extra labour of drawing in a heavy cable is worth considering, it should undoubtedly be taken into account, as also should be the *increased* cost of the culverts, &c, if these have to be made larger in size as the cable increases in weight. The most convincing argument of all in support of their contention, that those capital costs which are constant cannot affect the economical size of the cable, was one which every mathematician would appreciate at once. In order to obtain the minimum value of any quantity which is a function of another variable quantity, he differentiates both sides of the equation, and since the differential coefficient of a constant is zero, there could be no trace of this constant left in the differential equation, and it was therefore quite impossible that it should influence the size of the feeder. Mr. Nisbett mentioned excessive temperature rise as a possible limit to the size of feeders worked out on Thomson's law, but in practice this was not found to be the case, and for that reason it had not been referred to in the paper. If a dangerously high temperature were likely to occur at times of full load, two or more cables would have to be laid side by side, or the cross section of the single cable increased, according to which method proved to be the most economical. Mr. Nisbett also spoke of feeders as being buried in the ground, but this was bad practice; they should be always drawn into pipes or laid in culverts, where they were easily accessible, and could be added to when required. With regard to the 10 amperes of capacity current referred to in the paper, this was merely assumed in order to work out an example, but, as a matter of fact, a capacity current of 8 to 10 amperes, or even more, was by no means impossible or unheard of, and Mr. Nisbett seemed to forget the existence of rubber insulated cables, which, with their thin dielectric of comparatively high specific inductive capacity, took far more capacity current than paper insulated cables. The current due to the capacity of the cables was a totally different thing to the magnetising current of the transformers, and there could be no confusion between the two. Mr. Mordey, on the subject of capacity current, objected to its being spoken of as a quarter phase in advance of the E.M.F. This, however, was the usual way of expressing what was really the truth, and the question was, after all, only one of the choice of terms. There were undoubtedly two ways of expressing one and the same thing, and it was of course quite correct to speak of the current as lagging three-quarter phase behind the E.M.F.; but when dealing with the phase differences between two periodically varying quantities, there was no beginning and no end to be considered, and the displacement of one of these quantities with regard to the other could surely be expressed with equal accuracy, either by stating the amount by which it was in advance of the other, or by the amount by which it lagged behind.

Mr. Cowan, in reply, said that Mr. Rider, Mr. Wordingham and Mr. Nisbett had all criticised the suggestion that steam ought to be cut off the ring main during the hours of light load, as they did not believe it was practical, on account of the failure of joints likely to arise. If that was the case, why was it that cylinder cover joints did not give similar trouble. He thought that if the joints were properly made, and the steam pipes properly suspended, such trouble ought not to occur. Of course, great care must be exercised in admitting steam to a comparatively cold range of pipes, in the matter of draining, &c. It could not be done in a hurry. There seemed to be considerable doubt in the minds of many of the speakers as to the advisability of reducing the speed of the engine. Mr. Mordey and Mr. Lindley seemed to think that the object was to save losses in the alternator. This was not so, the saving effected was only in the engine, nothing was saved in the alternator. A good deal was made of the increased losses in the transformers, which would, of course, arise with the lower frequency. This point had been, he submitted, effectually answered in the paper, when the time came when the day load plant was loaded with a very large number of transformers, the only saving in the reduction of speed might be in "wear and tear," and it might not be considered worth while to continue the practice. He did not think there would be any great difficulty in designing a governor which could be adapted to control the engine at two different speeds. The tension of the springs should not be altered, but the leverage at which the weights acted, and the alteration must, of course, be made by hand, without stopping the engine. Mr. Lindley preferred an engine which gave nearly equal economy at all loads, from one-fifth to full load. But the question was not one of thermodynamic efficiency only, but *brake horse-power* compared with steam consumed. An engine which gave nearly equal economy at from one-fifth I.H.P. to full load, was the right kind of engine to instal for light load; but the saving due to reduction of speed was effected with that engine as well as with any other. On the question of the results of the reduction of frequency from the consumers' point of view, the only point raised was the effect upon motors. In reply to that, he would only say that he held the opinion, and always had held it, that motors were unfit for lighting circuits, especially alternating current motors, with their large idle current. He prophesied that if motors became popular, the electric light would become unpopular. It was impossible to regulate properly with alternating current motors on the circuits. Having come now to the proposed method of reducing the alternator losses, viz., by halving the induction, he was glad to have Mr. Mordey's support as to the saving being an undoubted fact. At the same time Mr. Mordey had misunderstood diagram No. 7, the curves on which were drawn to show that the losses in alternators varied nearly with the square of the induction. The plotted experiments were made with an iron cored alternator, but

experiments with Mr. Mordey's own alternator would follow the same curves; indeed, they would proximate more nearly to the true parabolas drawn, because the hysteresis loss peculiar to an iron cored alternator did not vary quite as the square of the induction. The objection to Mr. Rider's suggestion of putting an alternator down for light load which had no iron in the armature was chiefly its first cost; they thought it important to save the first cost and space occupied by a special light load plant. Mr. Rider seemed to think that 3·4 horse-power was hardly worth saving—it was more than that—but even 3 or 4 horse-power for 16 hours a day for 365 days in the year cost an appreciable amount, and was certainly worth saving in a small station. Mr. Mordey said that it was possible to design his alternator to give on short circuit no more current than an iron cored—quite so—but what then became of the characteristic? It was possible also to design an iron-cored alternator with as good a characteristic as Mr. Mordey's—at a price. Mr. Nisbett thought that they had overlooked the losses in an injector due to condensation of steam. He thought Mr. Nisbett had hardly done justice to the remarks made under this heading in the paper. They had given a great deal of consideration to the whole subject, and had come to the conclusion that nothing but careful and authoritative experiment could settle the point. They had looked up crowds of references, but had been unable to find any reliable results of experiments. He would ask Mr. Nisbett to reconsider the question, bearing in mind that all the heat in the steam went back into the boiler. Mr. Still had replied very fully to the criticisms of Thomson's law, but there was one point. Mr. Nisbett contended that if ¾d. per unit was taken as the cost of the energy consumed by the auxiliaries, that 1½d. ought not to be taken when considering the effect of the losses in the mains, but ¾d. The two problems were, however, entirely different. In the first instance the question to be settled was whether to drive the auxiliaries by the main engine—the main engine was running in any case, and therefore for the purposes of comparison, its standing losses would not be taken as chargeable against the auxiliaries; whereas the standing losses of a separate plant must be. That was surely good logic. But in the case of the losses in the mains the problem was different; there was no alternative to consider, and all losses as in meter shunt, transformers, mains, &c., should be charged at the full works cost, including fuel, oil, wages, &c., based upon the output registered by the station—not the consumers' meters.

Mr. Fawcus said: In rising to propose a vote of thanks to Mr. Cowan and Mr. Still for their paper, he would just make only one remark about the steam pipes. He was rather surprised to hear Mr. Rider and Mr. Hesketh tell them that they could not keep their steam pipes tight, and he pointed out that there were thousands of plants where the steam was shut off every day, and if electrical engineers could not do what steam engineers could, they had better learn. He had great pleasure in proposing a vote of thanks to Mr. Cowan and Mr. Still.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

NEW PATENTS.—1896.

6,890. "System of distribution of electrical currents." S. Berditschesky called Apostoloff. Dated March 30th.

6,925. "Electric water gauge." H. Biermann. Dated March 30th.

6,943. "An automatic electric light door switch." W. J. Fryer. Dated March 31st.

6,958. "Improvements in controlling gear for electrically propelled carriages or trucks." J. D. Bell. Dated March 31st.

6,980. "An improved electric boat propeller." J. Entwisle. (S. N. Smith and E. S. Baring-Gould, United States.) Dated March 31st.

6,981. "Improvements in electric batteries." J. Entwisle. (S. N. Smith and E. S. Baring-Gould, United States.) Dated March 31st.

6,993. "An improved coin-freed electric meter." R. Hacking. Dated March 31st.

7,000. "A process and apparatus for decomposing sodium or potassium chloride and generating electricity." L. Epstein and F. Marza. Dated March 31st.

7,005. "Improvements in electric hammers and the like." H. H. Lake. (A. S. Barnes and P. S. Skinner, United States.) Dated March 31st.

7,013. "Improvements in electric meters." J. Devonshire. (C. P. Steinmetz, United States.) Dated March 31st.

7,038. "Improvements in regulators for electric arc lamps." H. Baublin. Dated March 31st.

7,054. "Improvements in electrical signal systems for railways." L. C. Werner. Dated March 31st.

7,074. "An arc lamp for high voltages." A. J. Beaumont. Dated April 1st.

7,121. "A new method of making shades for gas, electric, or other lights." A. F. Davies. Dated April 1st.

7,140. "Improvements in mechanism for driving clocks and dials by electricity." A. Joyce. Dated April 1st.

7,151. "Improvements in differential automatic switches." F. H. Nalder, W. S. Crawley, and A. Soames. Dated April 1st.

7,161. "Improvements in or relating to electric light fittings." F. A. Chapman. Dated April 1st.

7,162. "Improvements in or relating to secondary batteries." A. J. Boult. (Julien, Belgium.) Dated April 1st.

7,166. "Improvements in electric fire alarms." M. A. Shanahan. Dated April 1st.

7,174. "A metal for heating by electricity." J. C. Green. Dated April 2nd.

7,195. "Improvements in dynamos." S. Z. de Ferranti. Dated April 2nd.

7,222. "Improvements in apparatus for manufacturing tubes by electrolytic deposit." A. S. Elmore. (J. O. S. Elmore, India.) Dated April 2nd.

7,237. "Improvements in electric fire alarms." I. T. Bomar. Dated April 2nd.

7,254. "Improvements in electric igniting devices for gas burners." G. F. Krieger. Dated April 2nd.

7,255. "Improvements in secondary batteries." H. H. Lake. (J. Julien, Belgium.) Dated April 2nd.

7,259. "Improvements in and in the construction of soluble metal electrodes for accumulators." W. P. Thompson. (J. Julien, Belgium.) Dated April 2nd.

7,318. "Improvements in electric heaters." E. E. Gold. Dated April 4th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps.*)]

1895.

6,708. "Improvements in submarine signal and search lights for use on board ship in thick and foggy weather and for look-out purposes." J. Clarkson. Dated April 2nd, 1895. Search and signal lights are arranged below the waterline so as to project their rays under water, and look-out chambers with glazed apertures are provided from which such submarine lights can be seen. 3 claims.

14,485. "Improvements in alternating current arc lamps." J. Devonshire. (C. E. Harthan, U.S.A.) Dated July 30th, 1895. A spring is provided to assist the series coil in regulating the arc, and the spring is so arranged that at the beginning of the movement of the magnet core when the power of the magnet is greatest, the spring affords very little assistance, when, however, the core has risen some distance into the coil and the lifting power of said coil is lessened, the spring acts more and more strongly to aid in lifting the core. 8 claims.

14,486. "Improvements in four motor reversing switches." J. Devonshire. (F. E. Case, U.S.A.) Dated July 30th, 1895. The four motors are connected together in pairs, the armature and magnet terminals of one pair being brought to one set of brushes and the corresponding terminals of the other pair being brought to a second set of brushes. The switch cylinder has three rows of contacts, the two outer rows being wide bars, and the middle row being narrow bars. These are so arranged that in one position of the cylinder the first set of brushes connect with the wide bars and the second set with the narrow bars; in the other position of the controller, the first set connect with the wide bars and the second set with the narrow bars. The narrow bars are cross-connected, so that all four motors are reversed in changing from one position to the other. 6 claims.

15,225. "Improvements in and connected with electric brakes." J. Devonshire. (W. B. Potter, U.S.A.) Dated August 13th, 1895. Relates to brake mechanism for cars in which the motors are propelled as generators by the momentum of the car when stopping, and supply current for operating the brakes. 45 claims.

15,787. "An improved electric connecting device applicable to electroliers, electric light standards, brackets, and the like." R. W. Braham. Dated August 22nd, 1895. "Rise-and-fall" electric light fittings are made with two telescopic tubes, the outer one having an insulating lining in which two insulated metal strips are provided. The lower ends of the strips are connected to the lamp terminals, and insulated brushes at the end of the inner fixed tube make connection with the strips in any position of the tubes. 2 claims.

18,034. "Improvements in oxidising lead and lead compounds for the construction of electrical accumulators." H. Leitner. Dated September 26th, 1895. The improvement consists in treating the lead with an alkaline hypochlorite, and after the outer layers have been attacked, the oxidation is completed by passing a weak current of electricity through the mass. To increase the conductivity, about 10 per cent. of carbon is added; this is oxidised, and disappears as the process continues. 2 claims.

18,939. "Improvements in dynamo generators or motors." A. de Puydt and M. Poncin. Dated October 22nd, 1895. Relates to improved devices for supporting the armature plates and securing them to the spindle, and also for connecting the armature coils to the commutator segments. Improved brush-holders for copper and for carbon brushes are described. Also an improved self-oiling bearing in which a chain carried on the shaft takes up the oil from a reservoir in the pedestal is described and shown. 6 claims.